RADIOLOGY

A MONTHLY JOURNAL DEVOTED TO CLINICAL RADIOLOGY AND ALLIED SCIENCES

EDITOR

Howard P. Doub, M.D.
Detroit, Michigan

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Diagnostic Studies with Radioactive Isotope Tracers[1]

K. E. CORRIGAN, Ph.D., and H. S. HAYDEN, Ph.D.

Detroit, Mich.

THE TECHNICAL utilization of radioactive isotopes for diagnostic procedures has followed a somewhat different line of development at Harper Hospital (Detroit) from that in many other institutions. While numerous details have been reported and some of them have been demonstrated before this Society previously, we would like at this time to present the entire procedure, and with certain illustrative cases try to show the advantages that this technic offers in the diagnosis and evaluation of cases of thyroid cancer.

Some parts of the technical procedure have been widely utilized elsewhere, and some radiologists who were trained at Harper Hospital are making use of the entire procedure in their own institutions throughout the country. In general, however, there has been a tendency to try to shorten the procedure and eliminate technical detail and professional labor. These efforts at simplification are very necessary, and any development which will reduce the cost and labor of the procedure, *without sacrificing accuracy*, is greatly to be desired.

The diseased thyroid gland usually is a highly discontinuous organ in which local areas of malfunction are probably the most significant diagnostic problem. The thyroid is a highly unreliable organ, and in any state of malfunction its location and distribution are seldom those shown in the books on anatomy. Prior to 1946, therefore, we became very much more interested in the exact outlining of each gland and the evaluation of its internal structure and discontinuities than in any procedure directed toward simple determination of its total activity, based on assumption of position and uniformity of function. As we have shown in a recent paper (1), the estimation of total function, either by total uptake, total excretion, or both, may lead to the evaluation of a gland as normal when in reality it contains serious non-malignant disease processes. In this presentation we will demonstrate that the same limitation applies to concealed malignant disease.

In 1946, the United States Atomic Energy Commission made available pure carrier-free radioactive isotopes. We should perhaps mention, in passing, that by this act the Atomic Energy Commission and its present Isotope Division probably made one of the greatest contributions to human welfare of all time.

It is essential to remember throughout

[1] From the Department of Radiology (Lawrence Reynolds, M.D., Director), Harper Hospital, Detroit, Mich. Presented before the Thirty-sixth Annual Meeting of the Radiological Society of North America, Chicago, Ill., Dec. 10–15, 1950. Received for publication in April 1952.

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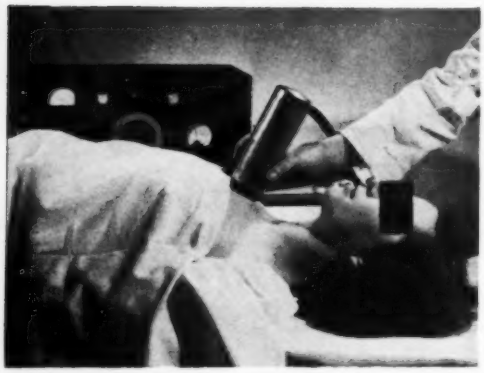


Fig. 1. Geiger counter scanning procedure.

all of this discussion that the chemical quantity of iodine represented by a tracer dose of carrier-free I^{131} is so infinitesimal that it is simply zero on the chemical scale. The carrier-free isotope technic, therefore, gave us a means of measuring the body's metabolism and economy of the element without adding anything which disturbs them in any way.

Since 1946, the Harper tracer technic has been used in well over a thousand cases: 895 were thyroid cases studied with I^{131}, 27 represented concealed nonmalignant thyroid disease which was successfully diagnosed by this method, and in 99 the thyroid proved to be normal. This last group deserves a word in passing, for the discovery of a normal thyroid in a person with nervous symptoms and a high basal metabolism rate has, in some cases, led to the discovery of an adrenal tumor or other serious non-thyroid disease previously unsuspected. Normals and known cases of thyroid disease of all types which we studied solely for our own enlightenment are not included in the statistics. Also eliminated are cases in which mixed isotopes were used and cases which showed chemical block, such as were first exhibited before this Society in Boston in 1947.

Seventy-six patients in our series proved to have malignant thyroid lesions. We propose to give detailed consideration to this group in the present paper.

Our technical procedure has been described in detail previously (2). In brief, the shipment of the isotope received from Oak Ridge is diluted to a standard volume, and aliquot samples are standardized by beta counting. Doses can then be delivered by simple volume measurement. One of the most important technical details, as we pointed out in our discussion of chemical block, is that the procedure must eventually result in accounting for 100 per cent of the tracer dose administered to a patient.

In studying the patient there are very specific observations which are made with the Geiger counter. The first of these is the anatomical localization of the active tissue. This is done by a scanning technic in which the use of the Geiger counter may be considered analogous to the use of a fluoroscope or a stethoscope. A loud speaker is used so that the operator can focus his entire attention on the patient and on his manipulation of the counter head. The type of instrument used is illustrated in Figure 1. While no fundamental change has been made in the instrument in ten years, the technical development has been considerable. Mechanical holding devices have been tried and have been found impractical, since they deny the operator his necessary flexibility. Snouts and collimators over the end of the counter tube have proved in every case to offer considerably more disadvantage than benefit. A properly chosen Geiger counter tube is a very satisfactory collimator in itself and requires only that its sides be protected with an adequate quantity of lead. Consequently the only covering used over the window of the tube is a thick lead cap with a small aperture which is employed only occasionally to improve precision localization in very small areas.

The inherent directional properties of the tube and the workings of the inverse-square law will be found to give a greater contrast in count rate between a small or weak localization and its immediate surroundings than can possibly be obtained with a tube used at a distance. The inescapable background from radioactivity

in the blood stream and scatter from the dense normal structures, such as the liver, spleen, heart, and the great muscles along the spine, can never be completely eliminated. Their normal behavior, however, is something so easily learned on rubber models and postmortem material that it offers no real problem, either in performing the diagnostic procedure or teaching it.

Originally the equipment had to be built in our own laboratory. More recently diagnostic equipment which gives simple and fast operation with high sensitivity and a beautiful degree of precision has been developed commercially.

For standard tracer procedure the patient is given 50 microcuries of radioactive iodine (I^{131}) in solution by mouth at 8:00 A.M., on an empty stomach. Intravenous administration is used only in patients who cannot swallow, since a large portion of the tracer will immediately appear in the saliva and gastric secretion in any case. Counts earlier than two hours after administration are not usually made, since gastric retention and absorption rate, particularly in a highly nervous thyrotoxic patient, may completely invalidate them.

At the two-hour interval a scanning study such as has just been described is done and specific observations are then made over a routine anatomical framework. The activity in both lobe areas and the region of the isthmus is recorded and, if aberrant localization is found or spots of marked hyper- or hypoactivity are detected in the gland area, these are, of course, also recorded. The concentration in the liver, spleen, and soft tissue of the thigh is invariably recorded and, if there is significant activity detected on scanning in the epigastrium or elsewhere in the body, this is also noted. Routine scanning of the ribs, sternum, lung fields, and the posterior cervical and supraclavicular lymph nodes is performed.

The recording of some of these observations may appear to be unnecessary, but in reality the anatomical framework forms a reference structure for future users of the data and, most important of all, for discovering future changes in the patient, such as recurrences and metastases. It is therefore necessary to note such apparently inconsequential things as the fact that there was no localization in the left lobe area at a certain time after surgery. Obviously, if the surgeon had missed a bit of tissue or if a new metastasis had developed, there would have been a localization, and this is an important fact.

Following this initial study, sequential observations are made for at least 32 hours. The frequency of these studies and the decision as to whether or not they should be extended to 48 or 52 hours depend upon conditions as they develop in a given case. In every case three complete studies are performed on the first day and two on the second. If localizations which may be transitory appear, the frequency of observations is increased in order to get a more accurate estimate of the uptake and subsequent rate of decrease at these localizations. In other words, a reference framework of time is used, chosen to suit the average case. The framework, however, is never allowed to dominate the procedure, and every case is studied individually.

Records are kept in terms of counts per minute, since this particular form of evaluation suits our dosage and counter geometry. These counts are interpretable in other terms, but as a usual thing, since the primary purpose is diagnosis, they are merely interpreted in terms of the normal range.

During the same time period that the counter observations are made, a urinary excretion study is performed. For this purpose each specimen of urine is collected *in toto* and its volume and time of voiding are recorded. Eventually an aliquot is assayed for radioactivity and the per cent contained per specimen can then be calculated. Specimens are never pooled, and this in itself is an extremely important part of the technic. Specimens are taken simply as they come, and in this respect, as in all others, the patient is encouraged

to be just as undisturbed as possible. The results of the analyses of these specimens are plotted, and a curve of total urinary excretion, which also shows rate of excretion and rate of change of excretion rate, is plotted against time. The second two factors mentioned are not usually plotted separately, since for all practical purposes they can be seen by inspection of the total excretion curve.

After all of these data have been collected, they are assembled and analyzed with particular reference to the following specific features:

1. The anatomical location of tissue which metabolizes the isotope.
2. The rate of uptake and total uptake of the tissue.
3. Discontinuities and non-uniformities in the tissue masses found, whether in the normal thyroid region or elsewhere.
4. Rate of decrease of any localization showing an unusual decrease from its maximum concentration.
5. The total urinary excretion.
6. The shape of the excretion curve.

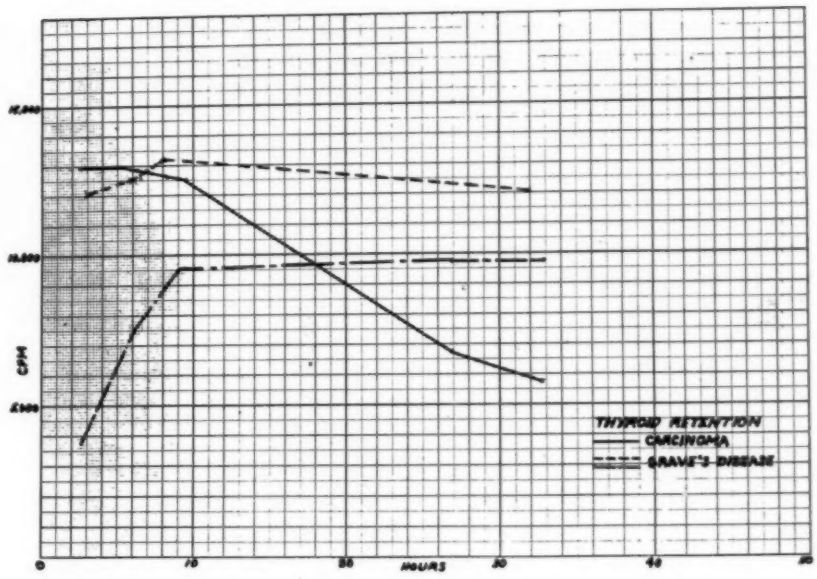
The isotope team does not consider medical or laboratory data, or radiological findings, until the conclusions from the isotope study have been written. The single exception to this statement is that both physicians and patients are asked for data having to do with chemical block. Upon completion of the isotope findings, all possible information having any bearing on the case is sought. If a discrepancy exists between the isotope findings and, for example, the radiological examination, this discrepancy is analyzed. We find these details of procedure to be absolutely essential to valid isotope work, since the real practical value of isotope technic is in solving those diagnostic problems not amenable to solution by standard clinical and radiological means.

As an example, it has been shown that only about 10 per cent of all toxic retrosternal thyroid adenomata proved by surgery had previously been demonstrated by even the most careful and skillful radiological study. Sometimes the isotope tracer technic will show bony metastases before sufficient bone damage has been done to cause pain or to produce any abnormality demonstrable radiologically. At the same time a very anaplastic carcinoma of the thyroid apparent on the roentgenogram may be difficult to demonstrate on tracer study. It is essential, therefore, that the isotope team do their work and draw their conclusions free of even subconscious bias and that, once the isotope procedure is complete, it be integrated into the entire study of the patient. Some specific examples illustrating this method of procedure may make this clear.

One problem that has been rather generally misunderstood arises from the fact that functioning[2] carcinoma can, in a certain percentage of cases, appear as Graves' disease. This situation can be resolved and the differentiation made by tracer isotope technic very much more easily and more surely than by any other method at present available. A "perfect" example, in the sense that every one of the salient features to be sought in identifying this condition is shown in the one patient, is that of a middle-aged woman who was referred to this laboratory. Her physician had made the diagnosis of Graves' disease.

Every possible presenting symptom was in agreement with this diagnosis. The patient recalled that she had lost 75 pounds in the past five years and that nervousness and tremor had increased. She had a basal metabolism rate of +75 per cent and a pulse rate of 120. Her breathing was rapid and somewhat difficult. She had staring eyes, a moist and greasy skin, a continuous tremor, and was generally hyperkinetic but extremely weak. She had an obvious smooth uniform enlargement of the thyroid which was reported as being firm but not unusually hard. The physician, who had read about radioiodine,

[2] "Functioning" versus "non-functioning" carcinoma of the thyroid is a highly artificial distinction. Essentially all carcinomas of the thyroid have adequate function for tracer diagnosis, although many have too poor a *retention* to respond to isotope therapy.



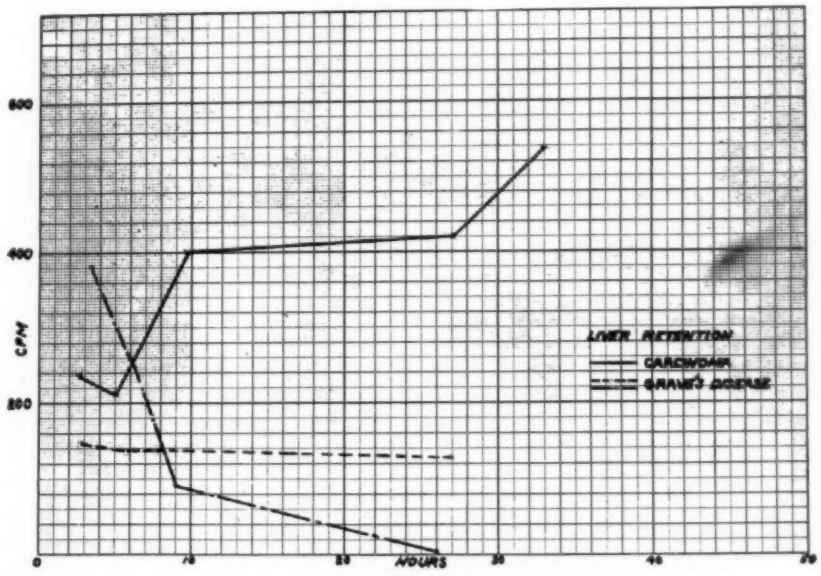


Fig. 2 (above). Retention curve typical of thyroid cancer.
Fig. 3 (below). Characteristic delayed uptake by the liver in the presence of functioning thyroid cancer.

sent her to us with an order to administer isotope therapy for Graves' disease.

The patient was given a tracer dose of 50 microcuries of I^{131} and the standard sequence of tracer counts was started. In Figure 2 this case is represented by the solid line. The count over the central thyroid region shot up to a abnormally high level within two hours. For the dosage given and the technic used, a normal thyroid would have given approximately 1,000 counts per minute in this area and it

will be seen that thirteen times normal beginning rate of uptake was found. If the tracer had been stopped here or at any period represented by a few hours, the diagnosis of Graves' disease would have been confirmed. It should also be noted that a single counter observation at 24 to 36, or even 48 hours, would still have shown nothing but a net toxic diffuse hyperthyroidism and an excretion study made on pooled specimens would have shown precisely the same thing. *This is precisely the reason why we prefer our longer and more difficult technic.* All areas of this particular thyroid showed uniform activity.

Also shown in Figure 2 are two cases of proved Graves' disease. In one case the net total thyroid function was greater and in the other less than in the case under discussion. The curves show the total activity and the rate of change with time found in the central thyroid region in each case. It will be seen immediately that in the two cases of true Graves' disease activity continued to increase up to the point where all of the tracer had been claimed from the general circulation, after which there was a leveling off, with a decrease at a rate consistent with the physiological half-life of radioactive iodine (I^{131}). The case under discussion shows the striking and perfectly definite difference of rapidly increasing activity only up to a certain point, followed by a decrease in intrinsic activity at an abnormal and characteristic rate easily distinguishable from the simple benign toxic hyperthyroidism.

This case illustrates two other very definite and reliable characteristics usable in distinguishing functioning carcinoma of the thyroid from benign toxic hyperthyroidism. Figure 3 shows the count over the liver on the same patient, again compared to the two cases of true Graves' disease shown in the previous figure (Fig. 2). It will be seen that in both of the cases of real Graves' disease the liver count dropped off in a normal manner as the thyroid depleted the reservoir of radioiodine in the liver. The patient under consideration, on the contrary, showed an increasing liver count. This is a reliable and repeatable characteristic finding in those cases having an adequate amount of thyroid carcinoma of the functioning type. It may not appear to any usable degree in the presence of a small malignant nodule or a large but poorly functioning carcinoma. It is, therefore, not so useful a criterion as the excretion curve. This particular case is an ideal one for illustrating the liver uptake in functioning carcinoma of the thyroid, although the same conclusions would have been reached if this observation had not been made.

We can do no more than postulate a reason for the liver activity, but it is our opinion that the normal or the benign hyperactive thyroid produces hormonal secretions, the metabolites of which are reclaimed and re-utilized by the thyroid. There is much good evidence to support this hypothesis. At the other extreme, the malignant growths apparently secrete in an abnormal manner and the liver uptake of their secretions appears to be an attempt at detoxification.

The liver uptake in the case described here was entirely uniform, and the liver could be outlined both anteriorly and posteriorly with the Geiger counter. It was not detectably enlarged, and there were no specific localizations of radioactivity which might represent liver metastases.[3]

If we turn now to the excretion study on this case, again compared to the two cases of Graves' disease (Fig. 4), we find that in the manner typical of all hyperthyroid conditions, the total excretion is low. It will be seen immediately, however, that the shape of the curve in this case is different from the shape of the curve in the other two cases. Ordinarily, in benign toxic hyperthyroidism the thyroid tends to conserve the portion of the radioactive tracer which it has converted; consequently there is excretion of inorganic radioiodine only through the first few hours, after

[3] Two cases with active liver metastases have appeared in our series.

which the curve levels off and subsequent increments of excretion are negligible. The cancer, on the other hand, continues to secrete something which the body cannot utilize and, although the chemical quantity involved is so small that we have not yet been able to identify it, its radioactive content after administration of a tracer makes it easy to detect and measure. It is perfectly definite that this material, probably a metabolite, continues to be excreted by the kidneys and appears as a continuously rising inflection of the excretion curve.

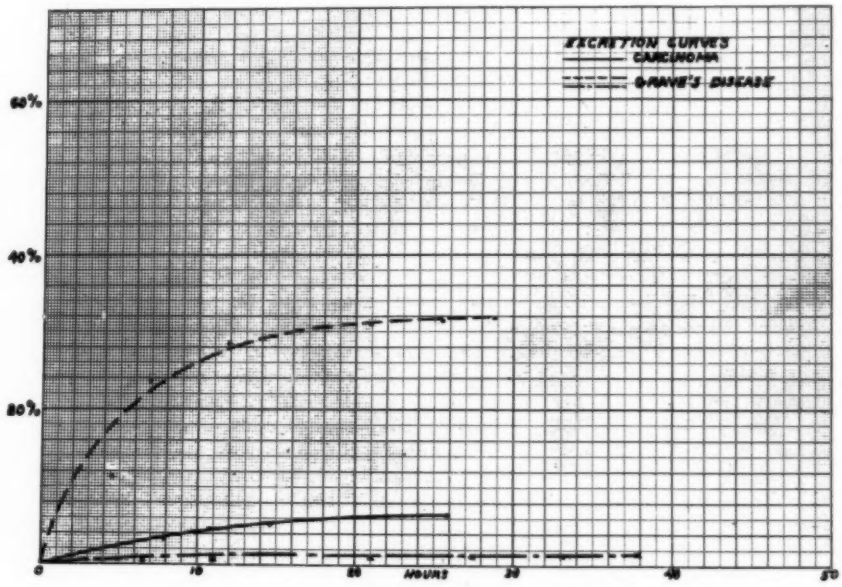


Fig. 4. Excretion studies.

To return to the specific disposition in the particular case under discussion: we, of course, reported on the basis of our tracer findings that we were dealing with a carcinoma and not a simple Graves' disease. The patient meanwhile had been admitted to Harper Hospital as a staff case and, throughout all of the studies just reported, had been seen by surgeons, internists, and numerous members of the resident staff. She had been studied in great detail by our radiological residents and National Research Council fellows who are trained in tracer technic. It was obvious that this patient was not a suitable candidate for isotope therapy. In the first place, it was necessary that the diagnosis be confirmed or disproved by some definite procedure. In addition to this fact, it was obvious that, with her high liver uptake and retention, a grave risk of liver damage existed if she received any dose large enough to offer a possibility of therapeutic efficacy. Treatment was conducted by the medical department with propyl thiouracil and sedation.

As will be seen in Figure 5, which is a running record of the basal metabolism rates for a period of five months, this treatment was successful in controlling the patient's toxic state. After a brief stay in the hospital, she was discharged to continue her conservative medication at home. She was kept under observation over a period of four months and at the end of that time was readmitted to the hospital for surgery. Repeat tracer studies were performed, and clinical and laboratory examinations were also done. Before preoperative treatment with Lugol's solution

B.M.R. RECORD

2/18/50	+57.9%
	+42.9%
2/24/50	+59%
3/31/50	+9%
4/3/50	+7%
6/4/50	+16.5%
7/26/50	-19%

Fig. 5. Basal metabolism record of patient with carcinoma of the thyroid (see text). Record of 7/26/50 is post-operative.

was started, the patient was given 500 microcuries of I^{131} in an attempt to have some radioiodine retained by the gland for the purpose of autoradiography. Later this proved to be highly successful.

The patient was started on heavy doses of Lugol's solution and propyl thiouracil in preparation for surgery. Part of the report of the clinical examination at this time is of particular interest, since it is in considerable contrast with the original state of the gland four months previously. In the examination of the neck, it was reported that the trachea was in the midline, the thyroid gland diffusely enlarged, nodular, and stony hard in parts. This change, if valid, had taken place in four months. There were no other significant changes, and neither clinical nor radiological examination showed metastatic involvement.

Operation was performed fifteen days after the second admission to the hospital and 9 days after administration of the 500 microcuries of I^{131}. The gland was found to be diffusely enlarged and was described by the surgeon as hard, with several firm nodules. He specifically mentioned, however, that it shelled out of its capsule easily and did not appear to be malignant. The gross specimen is shown in Figure 6, with a piece of tubing representing the trachea and showing the relative distribution of the gland. On gross examination, the pathologist reported the entire gland to be of firm meaty consistency and the cut surface uniform throughout. In the upper portion of the isthmus he found

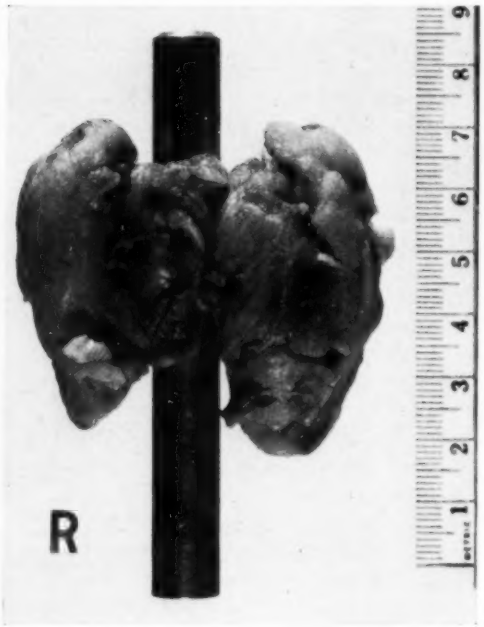


Fig. 6. Gross specimen of hyperfunctioning malignan thyroid.

a thin-walled cyst. On histological section (Fig. 7), the gland showed massive uniform cancer.

Since this was a functioning type of carcinoma, the uptake of the radioactive tracer had been excellent, as previously demonstrated by the serial tracer studies, and good autoradiographs were obtained (Fig. 8).

The patient had a completely normal postoperative course and left the hospital six days after operation. One month later a 50 microcurie I^{131} tracer study was again performed. By this time the patient had regained weight to 106 lb. and was in generally good health. She excreted a total of 74 per cent of the 50 microcuries. The tracer demonstrated

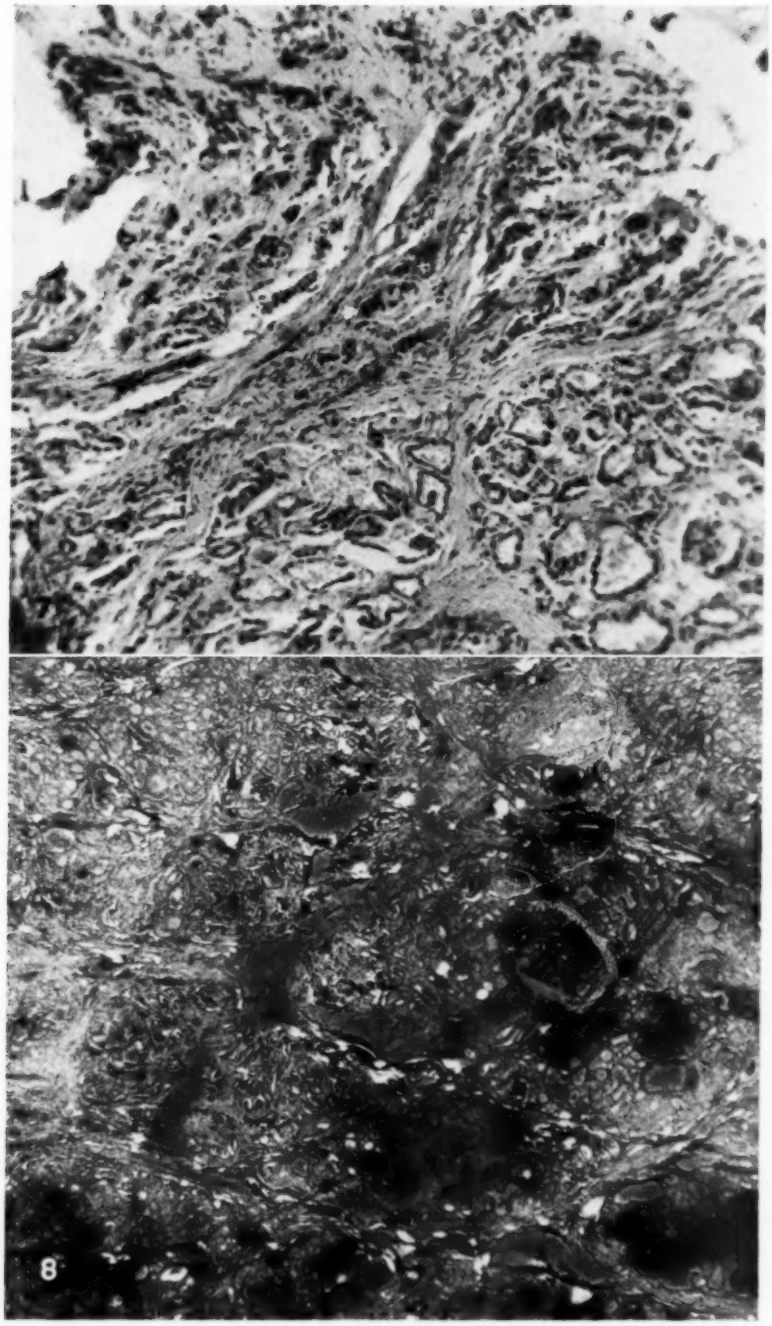


Fig. 7. Histological section from case shown in Fig. 6.
Fig. 8. Autoradiograph of tissue in Figs. 6 and 7. Areas of approximately normal function are shown.

tiny residues of tissue in the thyroid region, probably representing the pole parts of the gland and the tracheal adhesions which surgeons commonly find impossible to remove completely in attempting total thyroidectomy.

Very careful detailed studies were performed for the purpose of detecting lymph node invasion in the posterior cervical, peritracheal, or hilar regions. The bony thorax was studied along with the spine and other accessible parts of the skeleton. The liver was scanned in great detail with the Geiger counter, and at one point in the study the margin was found to be detectable but to have only 50 per cent more activity than tissue background. This type of liver concentration occurs in all sorts of conditions in which the body's water balance is disturbed, including incipient heart failure and some cases of myxedema. It is a totally different entity from the specific concentration previously discussed in relation to functioning carcinoma or to liver metastases. No metastases were found anywhere, and x-ray examination was negative. The only significant finding, therefore, appeared to be the tiny residues in the normal thyroid area.

In an attempt to destroy these completely before they could metastasize, a series of therapy doses of radioiodine was given over a period of five weeks, beginning with 25 millicuries. A final dose of 5 millicuries was given approximately two months after operation and no treatable localization could be detected, although detailed Geiger counter studies were continued for a period of ten days. The patient was in obvious myxedema. She was put on thyroid medication by her physician and is still alive and well without signs of recurrence at this time. Serial tracer studies will, of course, be continued at intervals of six months for an indefinite period.

This one case illustrates a total of 10 in our series of which 3 were originally detected as malignant by tracer technic and subsequently proved by operation; 7 patients were operated upon elsewhere for Graves' disease and referred to this laboratory postoperatively.

The urinary excretion pattern is probably the most significant single diagnostic indication of malignancy. In some cases it is not possible to find an area in the thyroid that will give any characteristic drop, such as we have illustrated. The primary cancer may be too small to be detected by any kind of a surface measurement (even though extensive metastases may be present), or metastases may be too deep or too inactive to give a sure result. The excretion curve pattern, therefore, deserves a rather more detailed consideration. Like many other chemical or physical procedures used for clinical determination (the Freedman, Kahn, bone density, etc.), it is at this time totally empirical but nevertheless highly reliable.

We may speculate that, unlike the normal thyroid tissue which re-utilizes the metabolites of its own hormone, as stated before, the malignant tissue is incapable of producing normal organic compounds of the iodine. The specific metabolic disturbances of malignant disease with respect to oxidative and enzyme chemistry have been well studied, and it is hardly to be expected that where the histological, cyto-architectural, and growth patterns of a cell type are radically altered, its chemistry should remain constant. In fact, it is highly unreasonable to believe that this could be so. The fact that it is not so is well demonstrated by the abnormal rate of loss of the tracer in contrast to its retention by normal tissue. If we may assume an abnormal secretion of radioiodine by the malignant thyroid cells, we may then speculate that the liver uptake is some attempt at detoxification and that the product of detoxification appears in excretion. Regardless of whether or not this speculation is valid, the fact remains that the validity of the excretory pattern as an empirical test has now been demonstrated and proved by surgery or autopsy on so many cases that its existence is beyond challenge.

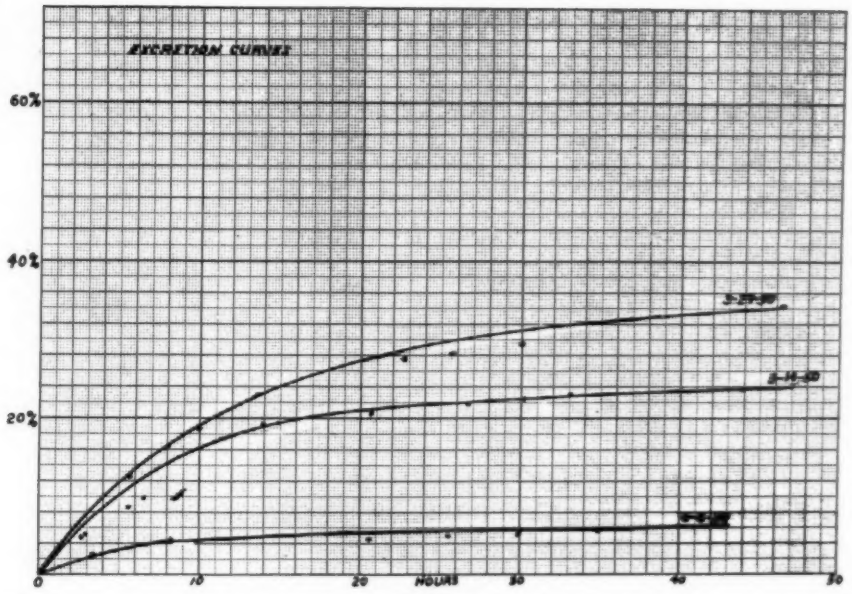


Fig. 9. Excretion curves with change in total thyroid function, showing no change in the type of function involved.

As in non-malignant thyroid excretion patterns, the height of the curve is determined solely by the quantity of functioning tissue present and to be accepted as valid must agree with the uptake measurements made on the patient. The characteristic point is the form of the curve. This is well illustrated in the sequence of curves (Fig. 9) obtained on this one patient: over a period of time the hyperthyroidism was brought down and subsequently went out of control just prior to operation, but in every instance, regardless of the amount of function present, the type of function was exactly the same. For practical purposes it should be restated that, given a curve of this type, the first thing that must be considered is the possibility of chemical interference. The second is the possibility of occult interstitial edema (which, if present, will appear as a regular part of the counter determinations on the patient) and, if these two are eliminated, then thyroid cancer has at least a 94 per cent chance of being the correct explanation.

Fig. 10. Postero-anterior radiograph showing upper mediastinal mass.

The recognition of these curves by experience and by comparison to known normal and abnormal curves is no more difficult than many other procedures regularly and reliably performed, such as the evalua-

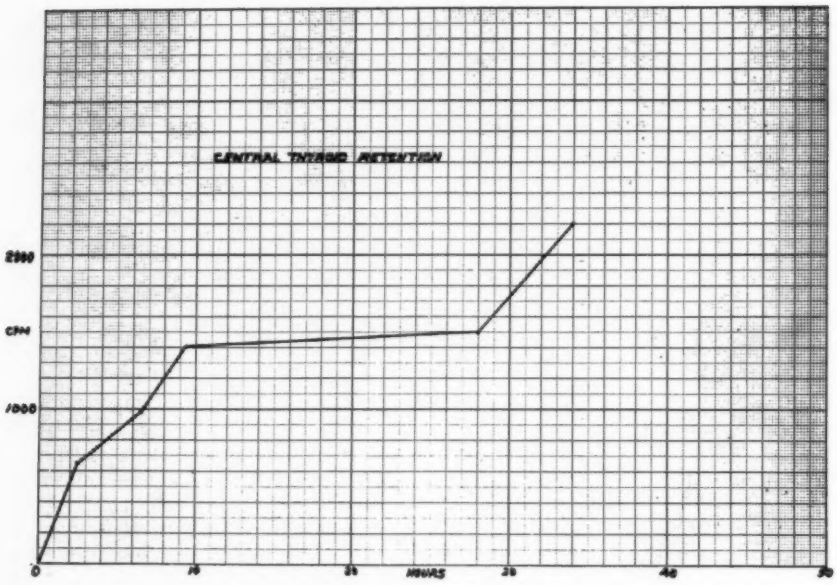


Fig. 11. Thyroid retention curve indicating weak and erratic function.

tion of kidney shadows. Anyone having the necessary fundamental training can be taught the entire tracer technic in not more than three months in an active department where a reasonable number of cases are available.

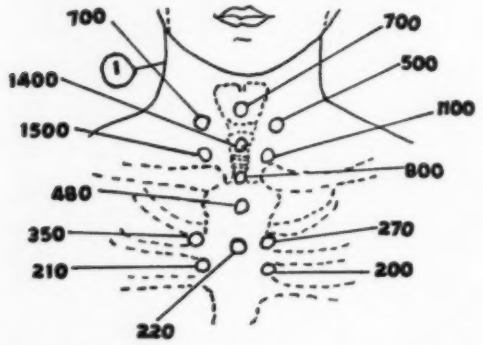


Fig. 12. Tracer map identifying upper mediastinal mass as being of thyroid origin.

A second case illustrates, among other things, the fact that no one part of the tracer study can stand alone, and that all of the factors involved in uptake, retention, and excretion must be considered in order to make an evaluation. Figure 10 shows the chest of a woman with an upper mediastinal mass. This mass was considered to be an aneurysm, and there was good clinical evidence for this opinion. The patient had cardiac decompensation and difficult breathing. There was also occult tissue edema, although this was demonstrated first by the tracer study.

Figure 11 shows the activity in the central thyroid region following a 50 microcurie tracer. It will be seen that the rise is very slow and that maximum activity was not obtained until 34 hours after administration of the tracer. This is in contrast to an average of 26 hours for the normal and a much shorter period of time for the hyperactive thyroid uptake. The most significant part of this tracer study was, of course, the evaluation of the retrosternal mass, which was proved by the tracer to be thyroid (Fig. 12.) By way of comparison with the former case and those to follow, we would like to point out the slow rise in the central thyroid region, which is characteristic of this type of case in which the thyroid uptake is restrained by the trapping of the radioactive tracer. The activity in the liver, spleen, and soft tissue re-

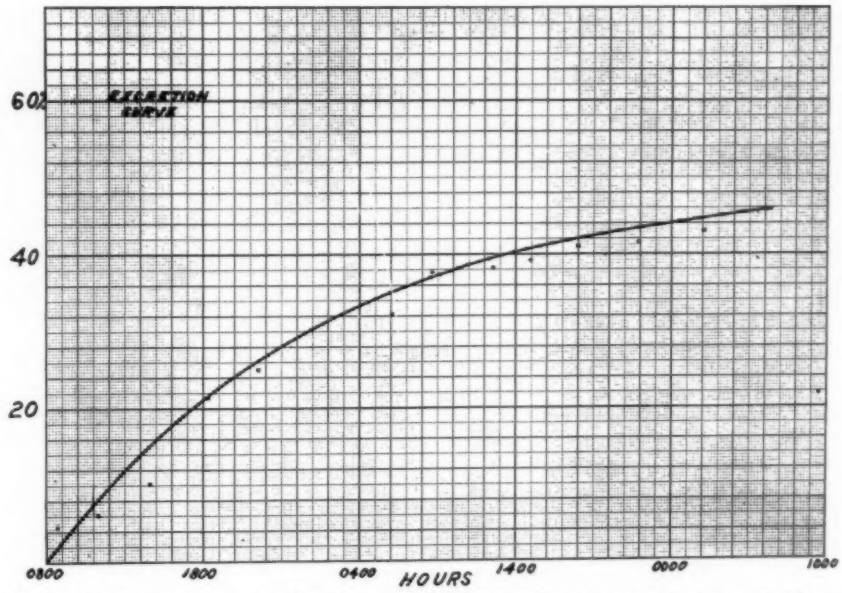


Fig. 13. Excretion curve approximating a straight line, showing distortion due to occult edema.

mained higher than normal throughout the entire study.

The excretion curve (Fig. 13), which was continued through a period of 46 hours, showed a total thyroid function just on the lower limits of the normal. This was in agreement with the uptake and retention studies. The shape of the curve, however, is highly abnormal and taken by itself might be considered as indicating malignant disease. It must be remembered that, where interstitial edema is present, a large portion of the tracer dose is trapped, and this very fact often aids in the diagnosis of beginning heart failure. At the same time it leads to abnormal tracer results with respect to the thyroid because the edema fluid slowly returns the tracer to the blood stream, and the uptake and excretion processes are continued over a long period. In this type of case, therefore, malignancy like toxic hyperthyroidism could be masked (3). If a degenerative ending appears on such a distorted curve, it must be reported, as this one was reported, simply as showing a degenerative change in the tissue. No one can say definitely whether or not malignant change is present.

Fig. 14. Gross specimen of mediastinal thyroid. Courtesy Wyman D. Barrett, M.D., and Wm. L. Brosius, M.D.

At operation the retrosternal mass was proved to be entirely thyroid (Fig. 14), and its removal cleared up the patient's respiratory and cardiac embarrassment. The pathological report showed cystic degeneration but no cancer.

In contrast to the foregoing case, we can take the example of a patient with a

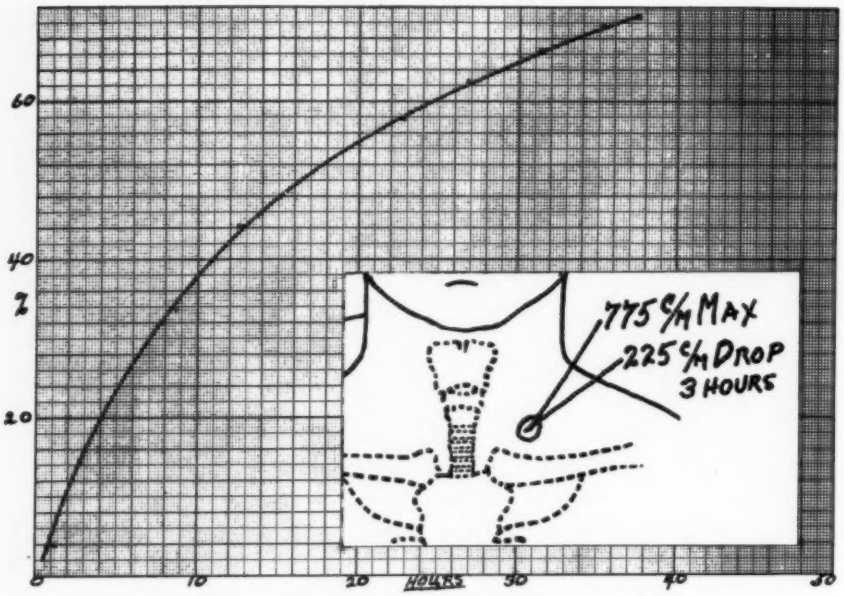


Fig. 15. Composite tracer map and excretion curve.

Fig. 16. Gross specimen showing malignant nodule with metastases (see Fig. 17).

nodular non-toxic thyroid which concealed an unsuspected carcinoma. In this case there were no complicating factors, the cardiac and water balance mechanisms being in good order. The patient was a 70-year-old white woman with a nodule in her right anterior thyroid region which gave a poor cosmetic effect. She went to her physician for this reason and insisted upon its removal. In view of the patient's age and the fact that she was in excellent health, with no significant symptoms, neither her physician nor the surgeon to whom he referred her was anxious to perform an operation. More as a means of satisfying the patient than for any other reason she was sent for a tracer study.

As shown in Figure 15 the tracer map quickly revealed that the mass about which the patient complained in the right anterior region was a simple non-toxic nodule. A completely unsuspected localization in the left anterior region, however, showed definite malignant characteristics. The excretion curve was of the typical mixed shape that arises when both normal and malignant tissue are present together in the gland.

For these reasons the patient was subjected to operation and a nodule, which had already formed two small local metastases (Fig. 16), was removed from the left anterior thyroid region. The histologic section showing malignancy is reproduced in Figure 17.

Serial postoperative tracer studies failed to show any residual tissue and no further treatment was given. The patient, who is a business executive, is still alive and in per-

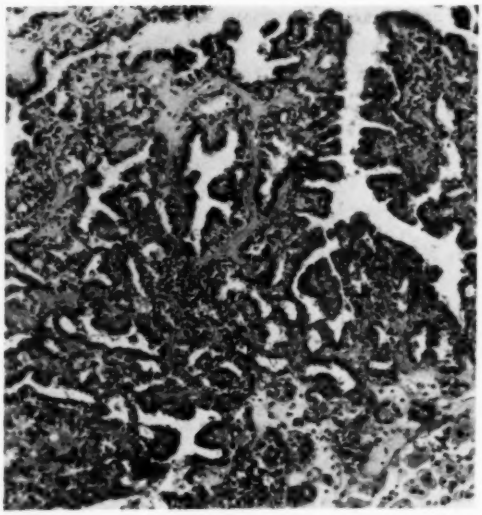


Fig. 17. Histologic section from specimen shown in Fig. 16.

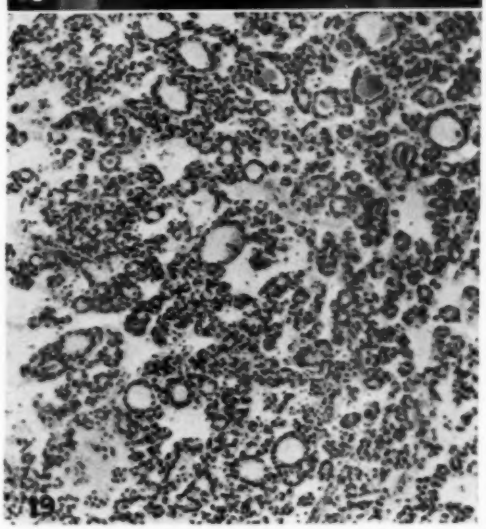


Fig. 18. Massive metastases of thyroid carcinoma.
Fig. 19. Metastatic thyroid carcinoma. Adjacent fields showed complete anaplasia. Courtesy Wm. L. Brosius, M.D.

fect health without signs of recurrence at the end of two years and eleven months.

A more discouraging type case was that of a patient studied from July 1947 through May 1948. In this case malignant disease of the thyroid was easily proved by tracer technic, but metastases which first appeared in the right lung proved to have no function demonstrable from the surface. Subsequently the thyroid in the normal location was destroyed by a combination of surgery, roentgen irradiation, and radioiodine. In spite of this, the metastases did not take on function. An early pathological report indicated bronchogenic carcinoma, and this case was considered for a time to represent a failure of isotope technic.

Subsequently (Fig. 18) massive bony and soft-tissue metastases appeared and were repeatedly demonstrated by tracer study to be of thyroid origin, but with only barely detected iodine retention. On two occasions the patient received thyroid-stimulating hormone without benefit.

Tissue obtained at autopsy (Fig. 19) proved to be highly anaplastic thyroid carcinoma.

In contrast to the previous case is that of a man thirty years old, who on three occasions, at the ages of seven, twenty-six and a few weeks before this study, had had small individual lumps removed from his neck. No information was available on the first two, but the third was proved on microscopic examination to be carcinoma of a lateral aberrant thyroid. A complete tracer study was not done on this patient, since the diagnosis was already established, but a 50 microcurie tracer was administered for the purpose of using standard technic to discover any other metastatic or aberrant localizations which might exist. Since the nodule removed two weeks previously had been shelled out intact, rather than cut off, it was with some surprise that

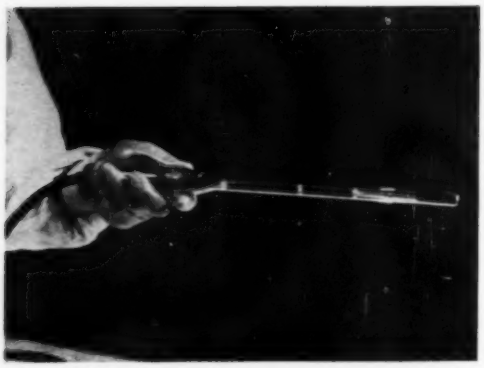


Fig. 20. Sterile probe Geiger counter.

we found a localization precisely beneath the surgical scar. Later there were also two unsuspected localizations, one far back in the right posterior cervical region and one behind the upper portion of the sternum.

The patient was then given a 250 microcurie tracer dose in time for the tracer to clear from his general circulation prior to operation. At the operating table, and before the skin was prepared, the regular diagnostic Geiger counter was used to point out these localizations to the surgeon. The thyroid was then removed and it was found that a hard nodule contained in the thyroid itself was responsible for the activity under the previous scar.

After all of the thyroid tissue detectable by visual observation or palpation had been removed, the surgical probe counter (Fig. 20) was introduced into the wound and showed strong localizations behind the manubrium and far posteriorly under the neck muscles on the right. The retromanubrial localization proved to be very difficult to find, but after several attempts the surgeon shelled out a nodule the size and shape of a small lima bean from beneath the periosteum on the internal surface of the manubrium. The posterior cervical localization on the right proved impossible to reach from the anterior approach and impossible to palpate. The probe was then inserted until the count rate showed that its tip was resting directly on the lesion. The skin incision was then extended and the muscles divided and retracted forward until the tip of the probe was found. When this was done, a dark colored spherical nodule was discovered and removed.

The gross tissue is shown in Figure 21. On microscopic examination this patient proved to be a "pathological museum."

Fig. 21. Gross specimen showing retromanubrial and posterior cervical metastatic localizations. Courtesy C. Benson, M.D.
Fig. 22. Autoradiograph of tissue in Fig. 21.

The malignant tissue is demonstrated in the histological section (Fig. 22). In addition, the sections showed various sorts of fetal adenomata and other growth aberrations. Postoperative Geiger counter study revealed no other aberrant or metastatic localizations.

The significant point of this case is that the two malignant aberrations or metas-

tases probably could never have been found except for tracer technic. Since these apparently represented all the residual cancer present, the tracer obviously gave the patient some chance of prolonged life which he would not have had otherwise.

The accuracy of the tracer result can best be indicated up to this time by the fact that of the 76 cases which we have called malignant solely on tracer findings and which subsequently came to operation or autopsy, only 3 have been proved to be non-malignant. Two remain questionable due to loss of the patient. Most important of all, up to this time no case judged non-malignant on isotope procedure has proved subsequently to be cancer.

We submit, therefore, that properly conducted isotope tracer technic carried out in a department of radiology and integrated into the regular life and standard procedures of the department can prove to be one of the most valuable diagnostic adjuncts brought forth since Roentgen's original discovery. It is equally valid to say that inadequate tracer technic, particularly any procedure based on a single observation, can be extremely dangerous and misleading.

We need only point out that, if the 10 cases of so-called Graves' disease reported in this paper had been treated as Graves' disease with radioiodine, some of the patients would surely have returned within a few years with cancer, caused by and resulting from isotope therapy.

Note: We are deeply indebted to Dr. P. F. Morse and Dr. Wm. L. Brosius for all of the histological work reported in this paper, and for many hours of consultation and help of every sort in the development of the technic reported here and the actual study of the cases. We also extend our sincere thanks to the many physicians and surgeons who by their co-operation made the study possible, particularly to Dr. Lawrence Reynolds, without whose constant support none of the work presented here could have been accomplished.

As of this time, March 26, 1952, 1,754 I^{131} tracer studies have been conducted with 107 diagnoses of a malignant growth of the thyroid. Of these, 11 were totally unsuspected on clinical or any other grounds and were first reported as malignant by tracer technic. In 4 of the 107 cases it has not been possible to demonstrate malignancy histologically, although in one of these patients metastases subsequently developed. In one case where a part of the excretion curve was lost, a malignant lesion was found that had not been previously reported. In the other 151 operated cases presented here, in which the original problem was to distinguish between malignant and non-malignant thyroid disease prior to operation and the tracer report was negative for malignancy, no malignancy has been found in any case.

Harper Hospital
Detroit 1, Mich.

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SUMARIO

Estudios Diagnósticos con Radioisotopos Despistadores

Descríbese aquí la técnica empleada para la utilización del yodo radioactivo para procedimientos de diagnóstico en el Hospital Harper (Detroit, Mich.) a la vez que se presentan casos que demuestran la aplicación de la misma al diagnóstico y a la justipreciación del cáncer tiroideo.

El enfermo recibe 50 microcuries de yodo radioactivo (I^{131}) en solución por vía bucal. A las dos horas llévase a cabo un procedimiento despistador con un contador Geiger a fin de localizar el tejido tiroideo activo. Luego se verifican observaciones específicas acerca de la actividad tanto de las zonas lobulares cuanto del istmo del tiroides. Si se descubren zonas aberrantes de actividad o puntos de pronunciada hiper- o hipoactividad tiroidea, son también registrados, e igualmente las concentraciones del isotopo en el hígado, bazo, y tejidos blandos del muslo. También se realiza una inspección sistemática

de las costillas, esternón, campos pulmonares y ganglios linfáticos cervicales posteriores y supraclaviculares. Después de este estudio inicial, se ejecutan observaciones subsiguientes a lo menos durante 32 horas. En todos los casos se hacen dos estudios completos el primer día y dos el segundo.

Durante el período de tiempo en que se aplica la técnica despistadora, se verifican también estudios de la orina, por parecer que ofrecen probablemente la indicación diagnóstica más importante de cáncer.

Los datos así obtenidos son analizados con referencia a: (1) localización anatómica del tejido que metaboliza el isotopo; (2) la velocidad de la absorción y la absorción total por el tejido; (3) las faltas de continuidad y de uniformidad en las masas de tejido descubiertas, ya sea en la región tiroidea normal o en otra parte; (4) la rapidez de la disminución en cualquiera localización que revele inusitada disminución de la concentración máxima; (5) excreción urinaria total; y (6) forma de la curva de excreción.

Las conclusiones sacadas de los hallazgos isotópicos son al final comparadas con las observaciones clínicas, radiológicas y de laboratorio, analizándose meticulosamente toda discrepancia notada.

La exactitud de la técnica despistadora queda indicada por el hecho que, de 76 casos diagnosticados como de cáncer sobre esa base, y que después fueron operados o autopsiados, sólo 3 no resultaron malignos. Ningún caso considerado como no maligno resultó ser maligno.

Design and Construction of a Multicurie Cobalt Teletherapy Unit

A Preliminary Report[1]

LEONARD G. GRIMMETT, PH.D.,[2] HERBERT D. KERMAN, M.D.,[3] MARSHALL BRUCER, M.D.,[4]
GILBERT H. FLETCHER, M.D.,[5] and JASPER E. RICHARDSON, PH.D.[6]

LATE IN 1949 the Medical Division of the Oak Ridge Institute of Nuclear Studies and the M. D. Anderson Hospital for Cancer Research entered into a joint co-operative program concerning the design, construction, and experimental testing of a multicurie cobalt teletherapy unit. The basic principles in design of the unit (1) were suggested and developed by Dr. Leonard G. Grimmett shortly before his unfortunate death in May 1951. The cobalt unit at that time was near completion at the General Electric Company's X-Ray Department in Milwaukee. Dr. Grimmett's years of experience with radium beam therapy units, his broad knowledge, and technical ability contributed greatly to the success of the project. To those concerned with the program, his association was a source of both pleasure and inspiration, and his death was an irreplaceable loss.

DESIGN OF THE EXPERIMENTAL MULTICURIE COBALT TELETHERAPY UNIT

The basic principles of the unit are exceedingly and purposefully simple, so as to minimize the possibility of mechanical or electrical failures usually inherent in any complicated design. Among the designs considered unsuitable were those using pneumatic transfer of radioactive sources from storage vaults, those employing hydraulically displaced mercury as a protective barrier and shutter mechanism, and those utilizing fixed and multiple beams. These were discarded because they failed to meet the principal requirements of simplicity and safety of operation, protection to personnel, and ease in clinical adaptation.

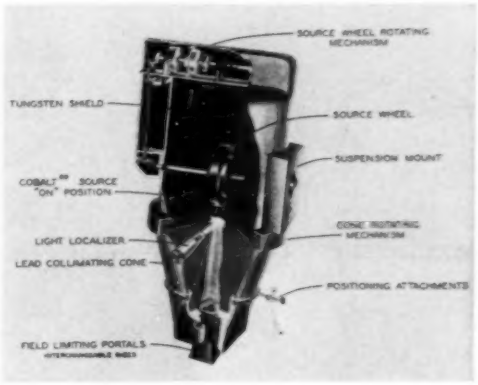

Fig. 1. Semi-schematic drawing of the Leonard G. Grimmett telecobalt unit.

The machine consists essentially of four components: (*a*) the source, (*b*) the source container, (*c*) the shielding head and rotating mechanism, (*d*) the collimating cone and applicators. The schematic diagram of the unit shown in Figure 1 demonstrates these essential features.

The radioactive cobalt is mounted on a rotating disk contained in a mass of protective metal which screens the cobalt completely in the "off" position. When the source is moved opposite the channel in the collimating cone, the unit is "on"

[1] From the Medical Division, Oak Ridge Institute of Nuclear Studies and the M. D. Anderson Hospital for Cancer Research, Houston, Texas. Presented at the Thirty-seventh Annual Meeting of the Radiological Society of North America, Chicago, Ill., Dec. 2–7, 1951.
A portion of the cost of this project was supplied by the Damon Runyon Fund as a grant to the M. D. Anderson Hospital for Cancer Research.
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[6] Assistant Physicist, M. D. Anderson Hospital for Cancer Research, Houston, Texas.

and the gamma ray beam is projected through the cone. Applicators of different sizes at the end of the collimating cone are necessary to delimit the field size.

(*a*) *Source:* The desired activity of cobalt chosen for this unit was specified to be approximately 1,250 curies. This will yield an *effective curie* value of approximately 1,000 curies, allowing for self-absorption of the activity within the source. A source of this level of activity seemed desirable to provide a useful intensity for treatment balanced with the continuing decay of Co^{60}, which is approximately 1.09 per cent per month. This high-intensity source yields the most economical and practical beam. The calculated value of the initial intensity of 1,000 curies at 50 cm. source-skin distance is 90 r per minute.

It was realized that a source of this high specific activity could not be obtained with the existing facilities in the United States, and arrangements were made through the Isotopes Division of the U. S. Atomic Energy Commission to have the source irradiated at the Canadian high-flux nuclear reactor at Chalk River, Ontario.

The size of the cobalt source is of prime importance in relation to the size of the penumbra cast on the skin surface when any collimating system above the skin is used. It is advantageous to use a Co^{60} source of the smallest dimensions possible. From the standpoint of specific activity per gram, the most practical source size which can be made in the available nuclear reactors is not larger than a 2-cm. cube. After considering many shapes of metal, it was decided that a source consisting of four square wafers, each $2 \times 2 \times 0.25$ cm. was most suitable for neutron irradiation in the Chalk River pile. These wafers can be mounted independently for irradiation so that homogeneous activity is obtained; after irradiation, they can be assembled to form a source $2 \times 2 \times 1$ cm., as shown in Figure 2.

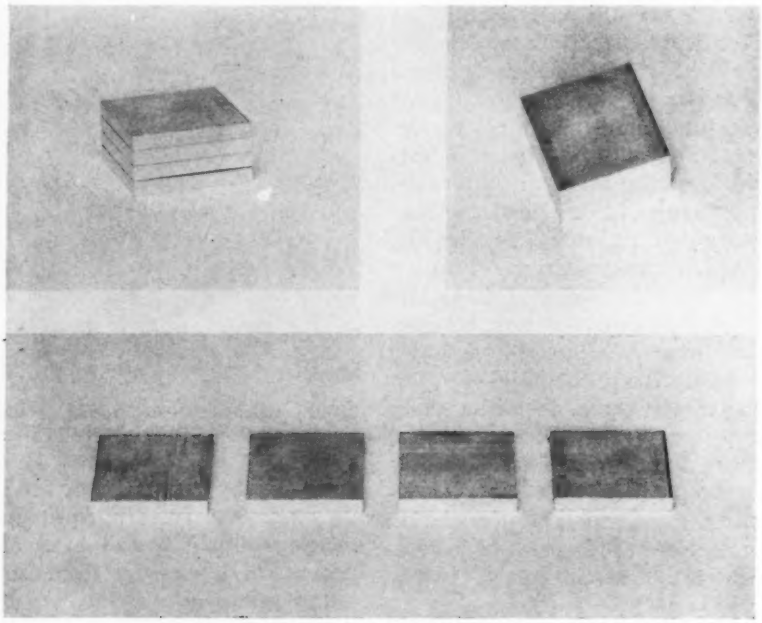


Fig. 2. Facsimiles of the Co^{60} wafers comprising the radioactive source. Each wafer measures $2 \times 2 \times 0.25$ cm. These are irradiated individually and assembled to form a radioactive mass of $2 \times 2 \times 1$ cm.

(*b*) *Source Container:* An important problem in the handling of radioactive cobalt is the flaking of radioactive cobaltic oxide from the metal surface. The solution of this problem lies in plating the surface of the radioactive material with some element which will prevent flaking of approximately 20 lb. on the cap causes cold flow of the lead wire into the interlocking groove and results in a seal which is dustproof and cannot be broken except by excessive force.

In order to mount the source container into the rotating disk, screws are positioned in the ears on each side of the container and held in place by small retaining rings. The source container is inserted into a machined recess in the rotating disk and held in position by a small Alnico magnet embedded in the floor of the recess. The screws are then seated, affording positive fixation. The entire assembly can be accomplished by remote control devices.

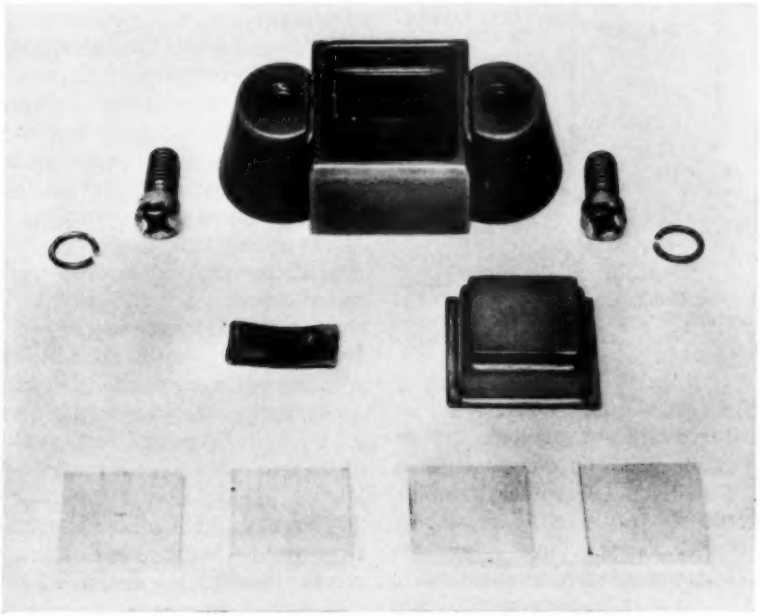


Fig. 3. Source container and cobalt wafers disassembled. The four wafers are placed within the source box, held in position by a small spring, and the cap is sealed by means of cold flow of a lead wire into an interlocking groove between cap and box. The screws hold the source container in place in the rotating disk of the head.

or enclosing the Co^{60} in some type of container. Since we were using a source of high specific activity, it seemed desirable to design a protective container which would enclose the activity and facilitate handling and insertion into the unit. Accordingly, the source container shown in Figure 3 was designed. This container, fabricated of soft steel so as to be handled magnetically, consists of a small box into which the cobalt wafers can be inserted. A spring to prevent undue motion is placed on the wafers, and the cap is positioned over the box. Sealing of the cap is accomplished by means of a fine lead wire held in an interlocking groove between box and cap. A directed impact

(*c*) *Protective Head and Shutter Mechanism:* In considering the type of material necessary for a shielding head, many metals were examined. Uranium and the noble metals would give the most compact and also the lightest machine. Although teletherapy units have been made with

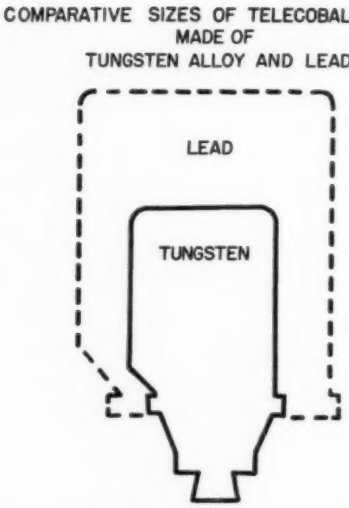


Fig. 4. Diagram illustrating comparative sizes of telecobalt units made of tungsten alloy (Hevimet) and lead. The tungsten head measures 13 inches in diameter and weighs 1,400 lb.

uranium (2) as a shielding head, uranium is not freely available at present. Even if it were possible to procure enough for a single unit, it is inconceivable that similar amounts could be obtained for general distribution and usage. Gold also was considered, but was discarded for similar reasons. The two elements which are commonly employed as protective materials are lead and tungsten. Lead being readily available, cheap, and easily fabricated, seemed the best material. However, in view of the size of the unit, we were impressed by the fact that a tungsten alloy would yield a smaller, more compact unit, and at that time tungsten was available at a price not much higher than that of lead.

Figure 4 demonstrates the comparative sizes of units made of lead and of a tungsten alloy (Hevimet) of 90 per cent W, 5 per cent Cu, and 5 per cent Ni composition. Calculations using narrow beam absorption coefficients gave a ratio of 1 to 3 for the relative weights of lead and tungsten necessary to give the same degree of protection. It was felt that this reduction in size and weight justified the extra expense of the tungsten alloy.

Since it was impossible to cast a single piece of tungsten alloy of the dimensions required, five disks of Hevimet, 3 in. thick and 13 in. in diameter, were obtained. These were machined to ordinary workshop tolerances and bolted together. The central rotating disk, 7 9/16 in. in diameter, was also made of Hevimet. In the study of the design, the question of radiation leakage between the machined surfaces of the disks was raised, and in experiments still unpublished Grimmett and Shalek (3) were able to demonstrate that the leakage between plane metal surfaces, machined to ordinary workshop standards, was negligible. However, in the course of these experiments it became apparent that there would be considerable scattered radiation at the end of the treatment cone with the source in the "off" position. By providing a "step" in the central rotating disk and modifying the shield accordingly, the pathway of scattering is effectively obstructed so that the intensity at the end of the cone is reduced to tolerable levels.

The calculated dimensions of material required to limit the dose rate to 10^{-4} r/min. (0.3 r/wk.) at a point 10 cm. from the surface of the unit are not in exact agreement with measurements obtained using a preliminary 200-curie source[7]. Possible explanations for this discrepancy may be found by considering multiple scattering and the scattering through the various metal surfaces of the disks. Another consideration is the small amount of tungsten removed to make the recess for the source. It is felt, however, that even though the dose rate at the surface of the unit will be higher than the calculated quantity, no undue risks will be incurred in ordinary clinical usage and extra shielding will be unnecessary. Further studies of this problem are now in progress.

Preliminary measurements using the 200-curie source produce the dosage dis-

[7] The unit has been loaded with a source of approximately 200 curies, which yields 15.5 r at 50 cm. focal skin distance. We are indebted to Dr. Max Cutler, Chicago Tumor Institute, for the loan of this source.

tribution about the unit in the "off" position as shown in Figure 5.

The rotating mechanism, devised by the General Electric Company's X-Ray Department, consists of a small electric motor coupled through a magnetic clutch to the Hevimet disk carrying the cobalt source. In the "on" position the motor continues to run, the clutch slipping continuously, holding the Hevimet disk against a fixed stop. When the motor is switched off, a coil spring in the housing brings the Hevimet disk back to the "off" position. This mechanism seems positive and definite in action and safe in case of power failure. The time of rotation for the "off" to "on" position is four seconds, and return to the "off" position takes less than one second. A handwheel is also provided for rotating the source to its "off" position in case of power and spring failure.

(*d*) *Collimating Cone and Treatment Applicators:* The collimating cone is made of lead and is mounted to the shielding head by means of raceways and bearings so that the cone can be rotated in a vertical plane. A small, light localizer, using an aircraft lamp, is mounted within the cone on a cylindrical lead plug. This gives quite adequate illumination without the troublesome problems of heat dissipation. The light beam falls on a small mirror fixed at a 45° angle in the beam of radiation, and the projected light outlines the treatment field.

The collimating cone measures 31.2 cm. in length. The lower end is formed by a bronze casting which is provided with two holes for locking pins to receive the treatment applicators.

The treatment applicators will be fabricated of lead with a variety of field sizes. The largest of these will give a 15 × 15-cm. field, and the heaviest will weigh approximately 25 lb.

A problem of some concern is the electronic emission from the inner surfaces of the collimating cone and treatment applicators (6). The inner surface of the collimating cone is lined with 18-gauge SAE 10-20 cold-rolled steel. Experiments

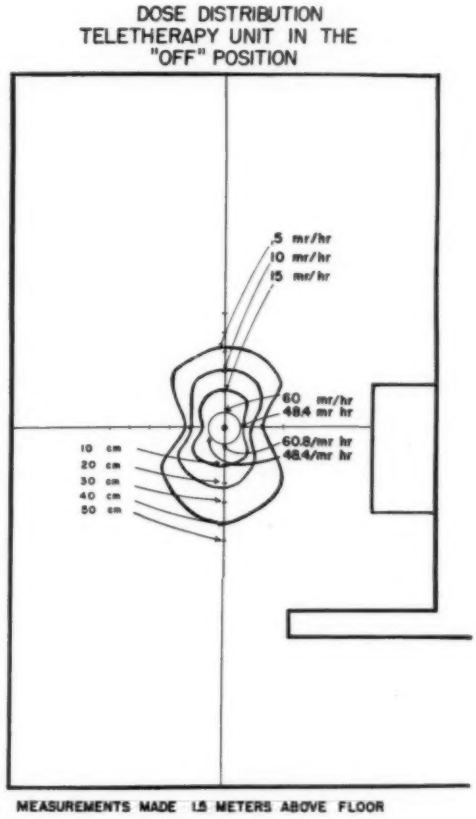


Fig. 5. Dosage distribution about the telecobalt unit (200 curies) when source is in "off" position.

now in progress will determine whether further sheathing of the inner surface of the cone and the applicators with a material of intermediate atomic number will be necessary to reduce this to a minimum.

HOUSING AND CONTROLS

Figures 6 and 7 demonstrate the general arrangement of the building constructed at the Medical Division of the Oak Ridge Institute of Nuclear Studies for the housing of the unit. It was fortunate that a site was available so that by excavation a ground level area could be utilized. As shown in the diagrams, the treatment room is fully covered by an earth fill. The direction of the primary beam is always oriented into the earth fill. Reinforced

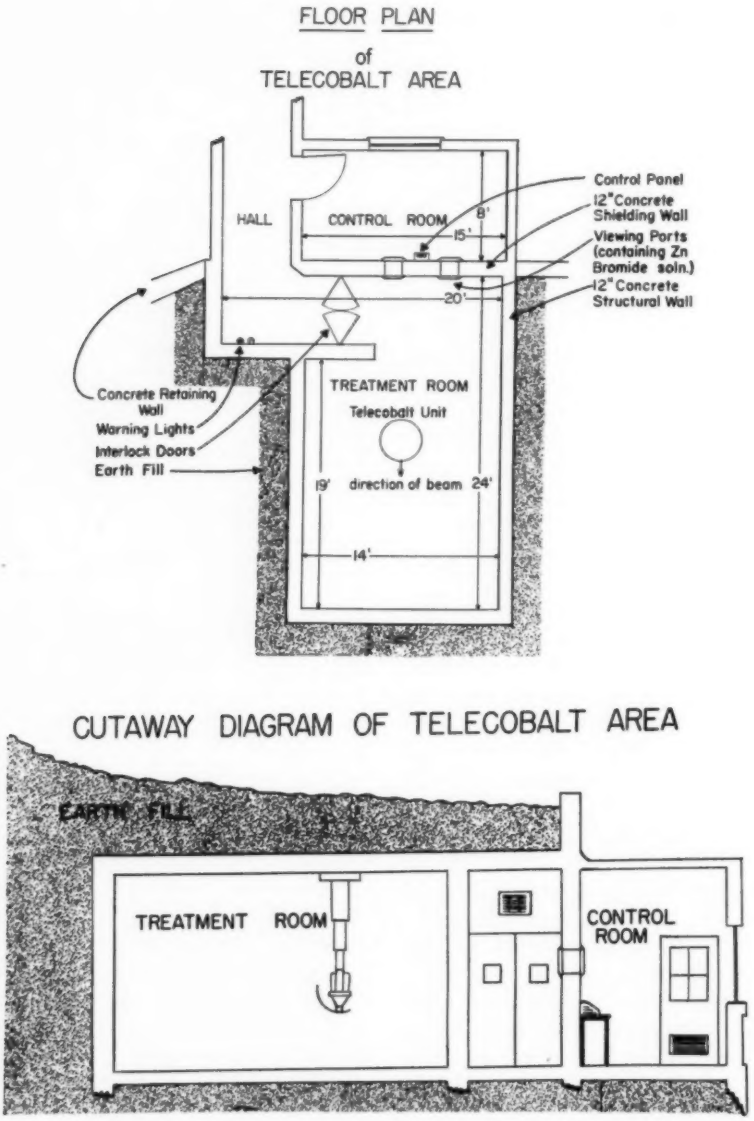


Fig. 6 and 7. Floor plan and cut away diagram of telecobalt area.

concrete structural walls 12 inches thick are used. The nearest point of personnel occupancy in these directions is 200 ft. The barrier between the control room and treatment room is made of packed concrete 12 inches thick and contains two viewing ports. The viewing ports are steel cylinders covered with 1/4 inch safety glass, backed with 1/4 inch lucite. These ports are filled with an 80 per cent $ZnBr_2$ solution with a density of 2.5. The refractive index of this solution is 1.5. Vision and light transmission through these ports is reasonably good, although the material tends to layer and must be used with extreme care because of its caustic properties. The density of this solution is adequate for reduction of

scattered radiation to tolerance levels. A maze was incorporated into the design to prevent scattered radiation reaching the hall area. Figure 8 shows the dosage distribution about the unit in an "on" position.

The unit is suspended from I-beams mounted in the ceiling, and has a 3-ft. vertical motion made possible by a telescoping counterweighted cantilever suspension. The beam will traverse an arc of 130° in one plane.

Interlock door switches, warning lights, and an emergency switch in the treatment room are circuited so that all must be functioning before the unit can be turned on.

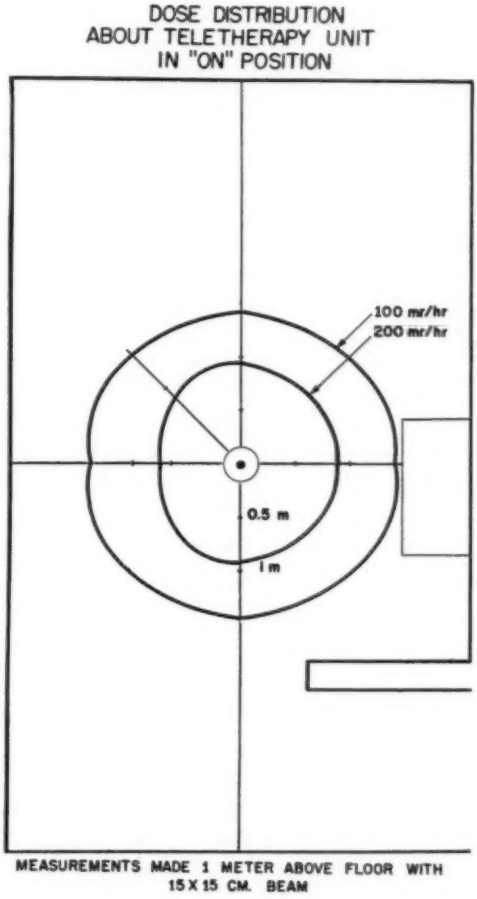


Fig. 8. Dosage distribution about telecobalt unit when source is in "on" position. Measurements of scattered radiation in air were made at 1.5 meters above the floor. Measurement at center of 15 × 15 cm. beam at 50 cm. FSD was 15.5 r/min.

LOADING MULTICURIE SOURCE INTO UNIT

The recent preliminary loading of 200 curies of Co^{60} into the unit was accomplished without serious difficulty at the Oak Ridge National Laboratory. The technic of loading this multicurie source as developed by the laboratory should prove to be adequate when the 1,000-curie source is available from the Chalk River reactor. The requisites of this loading were that the source be sealed dry to minimize oxidation of cobalt, and that no contamination be present. The sequence of loading may be observed in Figure 9 A–D.

The cobalt wafers are loaded under water, by means of a long pole electromagnet, into the source box, which is temporarily mounted in a large lead container ("monster") (Fig. 9A). The covering plug of the "monster" is fitted into place (Fig. 9B) and the container is hoisted out of the water. The source is now shielded so that working tolerance levels are adequate. The water is pumped and drained from the container. Acetone is flushed through the small tubes in the plug, followed by a continuous stream of hot air until complete dryness is obtained. The electromagnetic shaft through the center of the plug is de-energized and disengaged, allowing the cap of the source container to settle in place. A tube is placed over the upper end of this shaft and a weight of approximately 20 lb. is directed against the shaft so that the force of impact will cause cold flow of the lead wire into the interlocking groove between container cap and box, resulting in a dustproof seal (Fig. 9C). The "monster" is again lowered into the water, the plug is removed, and the source container is removed from its temporary fastening by a remote-control-handling screwdriver and electromagnet. It is then turned over and placed in the recess on the undersurface of the shielding head of the telecobalt

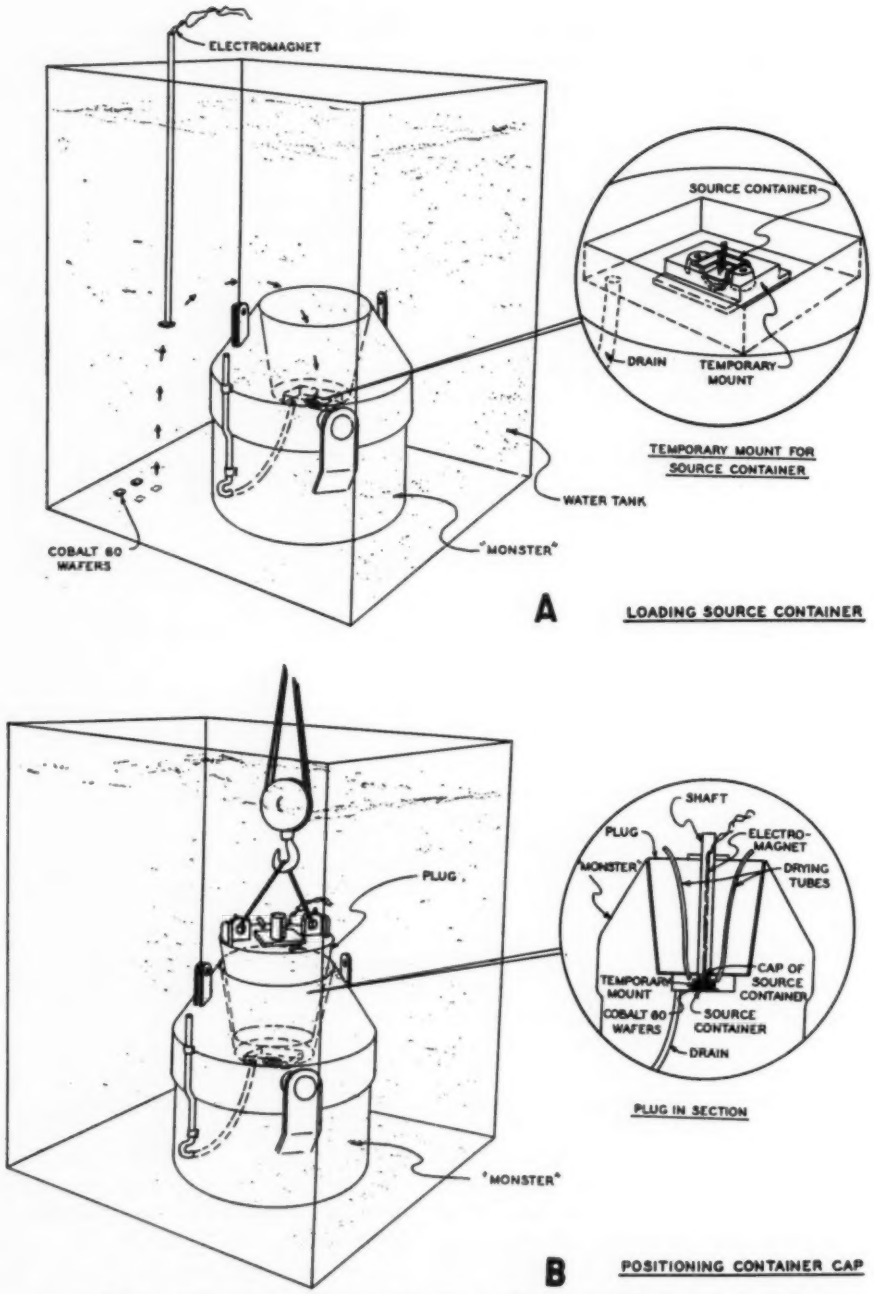
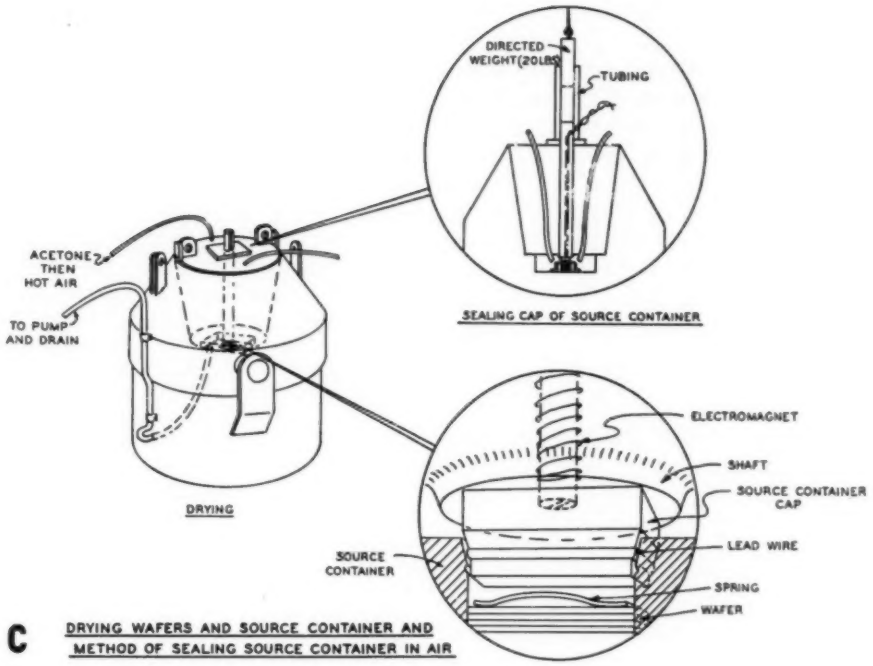
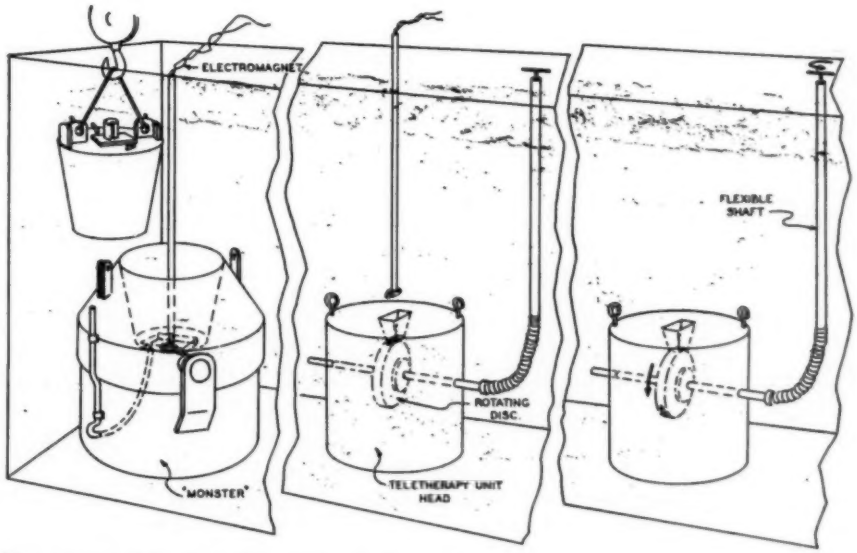


Fig. 9. Diagrammatic sequence of loading multicurie source into teletherapy unit.
A. Loading source container: The Co^{60} wafers are placed in the source container (inset) by means of a long pole electromagnet. The source container is mounted temporarily in the large lead "monster."
B. Positioning container cap: The covering plug (inset) of the "monster" is fitted into place so that the source container cap fits into the box of the source container.



C DRYING WAFERS AND SOURCE CONTAINER AND METHOD OF SEALING SOURCE CONTAINER IN AIR



D LOADING SOURCE CONTAINER INTO TREATMENT HEAD

Fig. 9. Diagrammatic sequence of loading multicurie source into teletherapy unit—*cont.*

C. Drying wafers and sealing source container: The "monster" has been lifted out of the water. The source is dried with acetone and hot air, and the source container cap is sealed (insets).

D. Loading source container into treatment head: The "monster" is again loaded into the water tank, the plug removed, and the sealed source container removed. The container is then positioned in the machined recess of the rotating disk of the teletherapy unit head and fixed in position with screws. The rotating disk is then turned to the "off" position with a flexible shaft, and the treatment head may then be removed from the water and assembled.

unit. The small Alnico magnet in the bed of this recess seats and holds the source container, and it is positively fastened into place by the screws in the source container ears. The flexible shaft attached to the axle of the rotating disk is then turned so that the source is rotated to the "off" position (Fig. 9D). The head may then be removed from the water, and the unit is then assembled.

FUTURE PROGRAM

Using the preliminary 200-curie source, further studies of the safety limitations of the unit and the beam will be made. The characteristics of the beam in infinite and finite phantoms will be studied, and integral dosage measurements obtained. Preliminary biological studies using the monochromatic beam will be instituted. When these studies are completed, the unit will be reloaded with the 1,000-curie source for further testing. It will then be transferred to the M. D. Anderson Hospital for Cancer Research for a long-term clinical evaluation of radiation in malignant disease.

CONCLUSIONS

We have presented the design and construction characteristics of a teletherapy unit utilizing as a radiation source an isotope of cobalt emitting essentially monochromatic gamma rays of 1.2 mev energy. The unit should compare quite favorably with existing supervoltage x-ray generators in the same range with respect to the considerations recently described by Hare (6).

NOTE: Acknowledgment is made for wholehearted co-operation, technical advice, and invaluable assistance, to the following: Messrs. E. Dale Trout, Arthur Kizaur, and John Vlack of the X-Ray Department, General Electric Company; Dr. Rex Fluharty and Mr. James E. Wilde of the Oak Ridge Institute of Nuclear Studies; Mr. E. Bailey Moore of the M. D. Anderson Hospital for Cancer Research; Mr. James Cox and Mr. Frank Tench of the Oak Ridge National Laboratory; Mr. Stephen Cobb of the Isotopes Division, Atomic Energy Commission; and Carboloy Department, General Electric Company.

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SUMARIO

Diseño y Construcción de un Aparato con Cobalto para Teleterapia en Multicuries. Informe Preliminar

El aparato de teleterapia con cobalto en multicuries aquí descrito emitirá substancialmente rayos gamma monocromáticos de una energía de 1.2 mev. Fué diseñado mediante la colaboración del Instituto de Estudios Nucleares de Oak Ridge y del Hospital M. D. Anderson para Investigación del Cáncer (Houston, Texas), constando de cuatro partes componentes: (1) el foco; (2) la casilla del foco, (3) el capuchón resguardador y mecanismo rotador, y (4) el cono colimador y los aplicadores.

El foco está compuesto de cuatro obleas cuadradas de cobalto, irradiadas por separado y reunidas para formar una masa radioactiva de 2 × 2 × 1 cm. La casilla está fabricada de acero blando a fin de poder ser manipulada magnéticamente, consistiendo en una cajita en la que se colocan las obleas reunidas, a las que mantiene en posición un muellecito. Un casquete va sellado sobre la cajita, montándose el todo sobre un disco rotatorio contenido en una masa de metal protector (amalgama de tungsteno). El mecanismo rotatorio consiste en un motorcito eléctrico

unido por un embrague magnético al disco que sostiene el foco de cobalto. En la posición desconectada, el cobalto queda completamente resguardado por el metal protector; una vez conectado, el foco queda enfrente del conducto del cono colimador de plomo por el cual se proyecta el haz de rayos. Los aplicadores terapéuticos son de plomo, de varios tamaños.

En el edificio que alberga el aparato, el cuarto de tratamiento está cuberto por un terraplén y emparedado con hormigón reforzado de 30 cm. de espesor. La valla que separa los cuartos de tratamiento y de regulación también es de hormigón de 30 cm. de grueso y contiene dos ventanillas de observación en forma de cilindros de acero recubiertos de vidrio irrompible, forrados de lucita y llenos de una solución al 80 por ciento de $ZnBr_2$. Hay además otros resguardos.

También se describe el procedimiento usado para cargar el foco, que tendrá una actividad de 1,000 curies.

DISCUSSION

Marshall Brucer, M.D. (Oak Ridge, Tenn.): As you may have been able to tell from Dr. Kerman's presentation of some of the details of construction of a cobalt^{60} unit, there are problems. There were times during the past few years when we were sorely tempted to go out and buy a 200-kv. machine and forget about the whole business.

One of the common questions that is asked in discussions of the use of artificially produced isotopes for teletherapy units is: "Aren't there some other isotopes that can be used?" There certainly are, and each has both advantages and disadvantages.

There are three good ways of making isotopes. One is by using the cyclotron. The expense of producing a multicurie isotope source in a cyclotron is at the present time prohibitive. The second way is by using thermal neutrons, the method used in the production of cobalt^{60}.

There are a number of isotopes that have better production characteristics than cobalt^{60} in a thermal neutron flux. If we consider only this point of production feasibility and economy, iridium, for example, is much easier to produce and could be made much more available; however, iridium has some drawbacks, chief of which is the 70-day half-life. I shudder to think of going through a loading and calibrating procedure every few months.

Another isotope is europium$^{152-154}$, which would be far easier to produce than cobalt^{60}. It could be produced in very large curieages, in very small sources, and its half-life is 5.35 years, about the same as cobalt^{60}. The radiation coming from europium, however, has a rather wide spectrum—0.1 to over 1 mev. There is another difficulty. Although you can buy cobalt by the pound, europium is the second rarest of the rare elements. We have 100 mg. It took us a long time to get it, and it is not pure yet. However, using the same reactor that we use with cobalt^{60}, we could get 36,000 curies of activity in the same size source that now gives us roughly 1,100 curies of cobalt^{60}. Europium presents an easy production problem, but first of all you have to get the raw europium.

Another isotope is thulium^{170}, which has a good cross section but only an 80-kv. gamma emission. Tantalum^{182} is now being used in very large sources for biological data, but it has a much shorter half-life and the amount of activity that can be put into a small source is not significantly greater than for cobalt^{60}.

Next in line of ease of production is cobalt^{60}. Then scadium^{46} or cesium^{134}. As can be seen, except for europium, all of these are in relative competition in the neutron economy. They do nothing better than cobalt^{60} and in many cases they have disadvantages which prohibit their use.

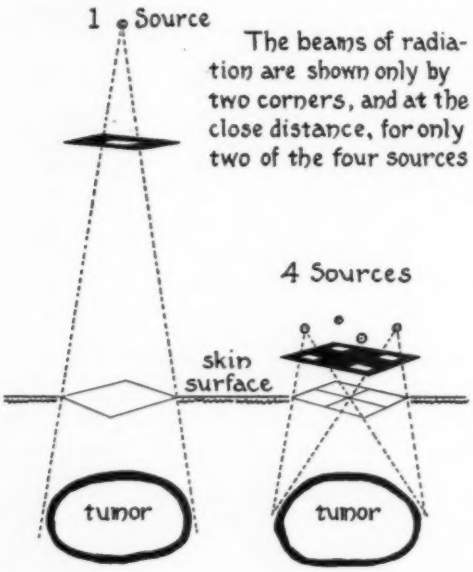
There is one other way of getting radioactive isotopes in large volume, and that is by using fission products. A number of reactors are in constant use, and there are a series of radioisotopes produced as a by-product. Of all the fission products that are available—and there are many of them—only one really fits all the requirements that have been set up for a teletherapy unit, namely cesium^{137}. Cesium^{137} should be available in comparatively large amounts. It should be relatively easy to get except that the problems are not those of neutron economy but of separating cesium in relatively pure form from the mass of other isotopes which are undesirable. This is a considerably difficult process in itself.

We have at the present time 2 curies of cesium contained in a very small source, 1 cm. in diameter, approximately 0.1 millimeter thick. The cesium source has a monochromatic gamma emission of 0.6614 mev and the radiation quality is about equivalent to that from a million-volt x-ray machine. The quality range appears good, but not every disintegration yields a photon, only about 0.95 per cent, and approximately 10 per cent of these photons are lost by an internal conversion. This is not a high yield of photons, but cesium appears to be the best source available

from the fission products, and it is the next upon which we will work.

R. R. Newell, M.D. (San Francisco, Calif.): In the face of difficulties shall we go over, under, around, or through? To go through is to do it in the dumbest possible way, just increase the power and hang the expense!

I have another way to look at it. When I was a boy I was taken to the circus and the principal attraction was the horseless carriage which went around the ring twice with no horses, not even any shafts. But on the dashboard—yes, it had a dashboard—was a whip-socket! Are we exhibiting some of the same conservatism? Our experience is with x-rays. These come in a single beam from a single source. Must we make the radioactive source in imitation of this?


1 Source
The beams of radiation are shown only by two corners, and at the close distance, for only two of the four sources
4 Sources
skin surface
tumor
tumor

I wish at least to consider multiple sources. The accompanying figure shows what I mean. A single source at 60 cm. irradiates a 7 cm. tumor 10 cm. deep. The skin area is 6 × 6 cm. The same tumor may be irradiated from four equal sources at 7.5 cm., each source irradiating a 3 × 3 cm. area, with total skin area 6 × 6 cm. as before. The ratio of skin dose to tumor dose (neglecting absorption) in the first instance is $(70/60)^2$. In the second instance it is $(17.5/7.5)^2$, which is four times as large. But there are four sources, each one used to only a quarter the dosage, so it balances out. But a source at 17.5 cm. from the tumor gives its dose in fewer milliampere minutes than at 70 cm. (distances measured from source to tumor) by a factor of $(17.5/70)^2$, which is 1/16. So, by moving to a quarter of the distance and using four sources instead of one, we get the treatment done in one-sixteenth of the time and do no greater harm to the skin.

Now take these to be cobalt^{60} sources and see that one needs only one-sixteenth as much total isotope, then each source is only one-sixty-fourth as large as what one needs in a single source and the self-absorption problem disappears. It is true that multiple sources are extravagant in the need for lead shielding, but they are economical in the use of isotope.

Paul C. Aebersold, Ph.D. (Oak Ridge, Tenn.): After listening to Dr. Brucer, it appears superfluous to put a physicist on the program to discuss this paper.

First, let me say that Dr. Grimmett designed a very beautiful teletherapy unit. Its mechanical performance is satisfactory, it is safe from a radiation standpoint, and I believe it will work out well from a clinical standpoint. Preliminary work shows that it will deliver depth doses at least equivalent to those of a 2 millivolt x-ray machine. Further, the unit is quite simple and presumably could be made rather inexpensive. I don't mean really inexpensive but relatively inexpensive.

I would like to add a few remarks to what Dr. Brucer has already said on the availability of high-intensity gamma-ray sources. It is now possible to produce very large amounts of radioactivity. We have made many thousands of curies of radiocobalt. Hundreds of thousands of curies of gamma-ray emitters have been produced as fission by-products in making plutonium. The only problem here is that the volume of the sources is generally larger than is desired for teletherapy purposes. The ideal is to obtain a source with 20 to 50 times more gamma ray output per unit volume than radium, and to produce this requires a high neutron flux reactor.

At Oak Ridge we have a graphite moderated reactor that is over eight years old, what we call a Model T reactor. It has a relatively low neutron flux. Under construction at Arco, Idaho, is a reactor that will have fluxes from 10 to 100 times greater than the one at Oak Ridge. With a flux 100 times greater, one can induce radioactivity in a piece of metal 100 times greater per unit volume than we can do at Oak Ridge. With the Arco reactor we will be able to make cobalt with as much as 20 to 50 times greater gamma ray output per unit volume than radium.

The only reactor now capable of doing this is in Canada, at Chalk River. It has a very high flux (up to 10^{13} neutrons/cm.^{2}/sec.). It is thus possible to produce highly radioactive cobalt with the Canadian reactor. The total output, however, is quite limited. Up to the present, only three large-scale sources have been produced at Chalk River, two for Canadian use and one for the Oak

Ridge Institute. They are irradiating more cobalt and should have several more kilocurie sources available in 1952. In the United States, however, we won't be able to produce anything like this until sometime in 1953. When we do start production of cobalt^{60} at Arco, we should obtain some very powerful sources. In time we should produce a large number of kilocurie sources; it is just a question of time.

It is also largely a question of time on some of the other sources that Dr. Brucer mentioned. We could make very intense radioactive sources of europium, provided we can get enough of the very rare europium to irradiate. Again, we would need a high-flux reactor like the one at Arco.

Now, about fission products. We get large quantities of fission products as by-products in the operation of any reactor. The only problem is to separate and concentrate them from the plutonium process effluents. The plutonium process at Hanford gives us plenty of kilocuries of activity but it is in solution form with a very low concentration. Although there may be millions of curies there, they are practically useless to us, unfortunately. However, some of our newer reactors and some of our newer production sites may produce fission products that are much more concentrated. We would then hope to produce concentrated fission product sources. We might concentrate as much as several hundred thousand curies per year. But in the case of cesium^{137} we can't concentrate the source to more than about 4 or 5 curies of equivalent gamma-ray output per gram of material. The volume of the cesium^{137} sources will thus be considerably greater than the Arco or Chalk River cobalt^{60} sources. This means that we will have to work out ways with cesium of using beams with broader penumbras or some type of device using multiple small sources to produce multiple small gamma ray beams which cross-fire through the region to be treated.

H. D. Kerman, M.D. (*closing*): In regard to Dr. Newell's comments, there is no doubt that multiple sources can be used to advantage in regard to economy of the isotopes. In isotopes which have low specific activity per gram (radium is an excellent example), multiple sources are probably the only way in which multicurie units can be made. However, to use an isotope which can be obtained in high specific activity in this manner is to sacrifice the considerable advantages of ease in clinical adaptability, simpler mechanical and engineering features, and flexibility of a single source unit. The engineering and extra shielding alone of a multiple source unit would seem to negate the alleged uneconomical use of the isotope. We feel strongly that a simple mechanism and a flexible clinical unit are the most desirable features.

Acute Miliary Diseases of the Lung[1]

BENJAMIN FELSON, M.D.[2]
Cincinnati, Ohio

THE PRESENCE OF disseminated miliary lesions in the lungs, demonstrable on the chest roentgenogram, is of frequent occurrence and is seen in a wide variety of diseases. More than 80 conditions capable of producing this appearance have been recorded (1–3). Such a long list of possibilities makes it extremely difficult to establish a clinical diagnosis in a given case, and any lead obtainable from the roentgenogram is of considerable help. For instance, roentgen evidence of associated enlargement of the hilar and mediastinal nodes, pleural involvement, or cardiac abnormality may suggest one or another etiology. Some writers have considered differences in sharpness, configuration, size, number, and distribution of the individual miliary nodules helpful in differential diagnosis.

An approach which has proved particularly useful in this institution, but which has not been emphasized in the literature, is the observation of change in the roentgen findings—specifically, the rate of progression or regression of the miliary appearance. The purpose of the present contribution is to evaluate the importance of observing and recording this rate of change, and to illustrate some of the conditions which can cause rapidly changing diffuse miliary lesions.

In a discussion of this sort it is important that the terms used be clearly understood. In the literature numerous descriptive expressions, many of which are vague, have been applied to the appearance under discussion: stippling, beading, mottling, diffuse infiltration, fibrosis, reticulation, honeycomb pattern, etc. Since miliary tuberculosis gives a rather consistent roentgen picture, which is well known, an attempt has been made to avoid confusion by describing the present material in terms of this disease. Our use of the word *miliary*, then, denotes a similarity to the roentgen appearance of miliary tuberculosis as regards size, number, and distribution of the lesions, and is not merely an indication of the millet-seed size of the individual nodules.

A completely uniform roentgen distribution of the nodules in the lungs is not stipulated, since a greater concentration in the central and basal portions is not uncommonly seen in miliary tuberculosis. This does not reflect the even distribution found at autopsy, the discrepancy being probably attributable to the greater thickness of lung traversed by the roentgen beam in these areas. Localized pulmonary emphysema may further modify the distribution as seen on the roentgenogram. The numerous disseminated diseases of the lung which fail to show a distinct miliary character are not included in this study.

Classification of miliary diseases into acute, subacute, and chronic categories offers certain advantages in differential diagnosis. We have used a grouping based on serial roentgenograms and not on the clinical course, which usually, but not invariably, coincides with it. This classification implies a *striking* change, progressive or regressive, in the visibility or distinctness, size, and number of the miliary nodules. With these points in mind the following time factors have been arbitrarily set:

1. Acute: Change demonstrated in less than two weeks.

[1] From the Department of Radiology, University of Cincinnati College of Medicine, and the Cincinnati General Hospital. Presented at the Thirty-seventh Annual Meeting of the Radiological Society of North America, Chicago, Ill., Dec. 2–7, 1951.

[2] Professor and Director, Department of Radiology, University of Cincinnati College of Medicine.

2. Subacute: Change apparent in from two to eight weeks.
3. Chronic: Failure to change within eight weeks.

It is a common experience at autopsy to find miliary lesions which have failed to register on a chest roentgenogram made a few days earlier. Roentgen visibility of the miliary densities is affected by a number of factors. Of these, the size of the nodules is probably the most important. The critical level of visibility is said to be 2 or 3 mm. diameter (4, 5). A difference of opinion exists as to whether each lesion, as seen on the roentgenogram, is a summation image due to superimposition of several nodules, or a real image of a single nodule (5, 6). In either event, the number and sharpness in outline of the nodules certainly play a role in their perception. Also of importance in their demonstration is a roentgenogram of good quality (small focal spot, suspended respiration, proper exposure and processing factors). Finally, the presence of other diffuse pulmonary abnormalities, such as emphysema or pulmonary edema, may affect the visibility of the miliary lesions.

MATERIAL

The index files of the Department of Radiology of the Cincinnati General Hospital of the past five years were examined, and the roentgenograms of all cases showing miliary lesions in the lungs were studied for evidence of acute change as defined above. Selected cases from the files of Children's Hospital were added, through the courtesy of Dr. Frederic N. Silverman. The acute cases, together with a review of the literature, form the basis of the present report.

ACUTE MILIARY DISEASES

A. Bacterial Infections

1. Miliary Tuberculosis: Following hematogenous dissemination of tuberculosis, the miliary tubercles are not visible on the chest roentgenogram for at least two and a half weeks, and even then they are so small they are difficult to distinguish as individual shadows. They soon become perceptible as numerous tiny nodules distributed throughout both lung fields. The nodules seldom get larger than 2 mm. in diameter and their size is rather uniform, although they may be somewhat larger in the upper than in the lower lobes. At first the individual nodules have a hazy outline, but as they mature they become more sharply defined. Coalescence may occur terminally. About half of the cases show associated intrathoracic abnormalities such as localized infiltrate, lymphadenopathy, or pleural involvement. Although miliary seeding of the lungs is not invariably fatal, the usual course is one of progression. The rate of change in the roentgen appearance is rather variable, but a number of cases fall into the acute category. Chemotherapy does not appear to alter the early roentgenologic course, and the nodulation does not begin to regress for four to six weeks after therapy is begun (7–11).

A review of the roentgenograms in 25 cases of miliary tuberculosis from the files of the Cincinnati General Hospital revealed findings which, in general, coincide with the above description taken from the literature (Fig. 1).

2. Other Bacterial Infections: Bacteria other than the tubercle bacillus very seldom cause acute miliary lesions in the lungs. Staphylococcus (4, 8) and Streptococcus (1, 12) may occasionally be responsible for an acute miliary pneumonia. Eight cases of bilateral "interstitial" pneumonia resolving in two weeks were mentioned in a description of a large outbreak of acute *Salmonella* infection (13), but the two roentgen reproductions did not show a true miliary appearance.

Only one case of acute non-tuberculous bacterial infection was found in our material. This was listed as a case of *Shigella* pneumonia (Fig. 2).

B. Virus and Rickettsial Infections

1. Chickenpox: Pneumonia is uncommon in chickenpox, occurring in less than 0.1

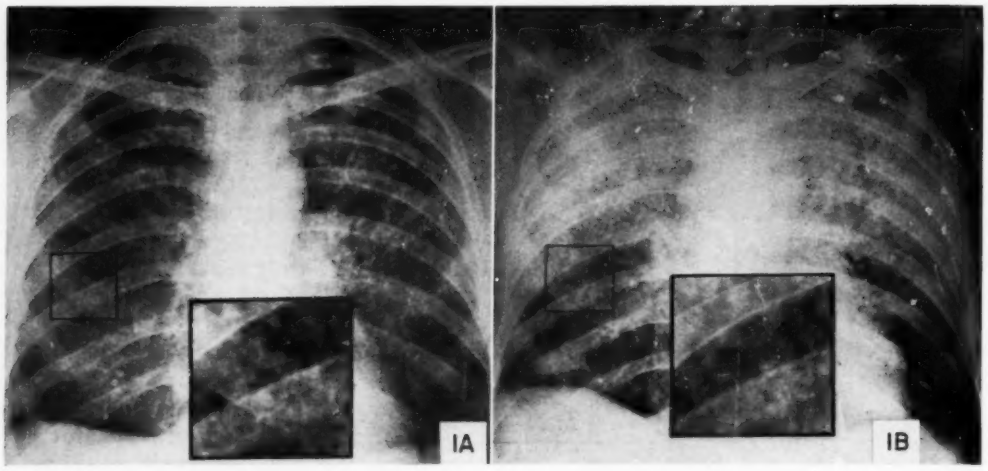


Fig. 1. Miliary Tuberculosis
White male, age 40, acutely ill for ten days before admission. A. Admission chest film. B. One week later Note progression, especially confluence in upper lung fields. Autopsy proof.
Insets on these and the following reproductions are enlarged × 4.

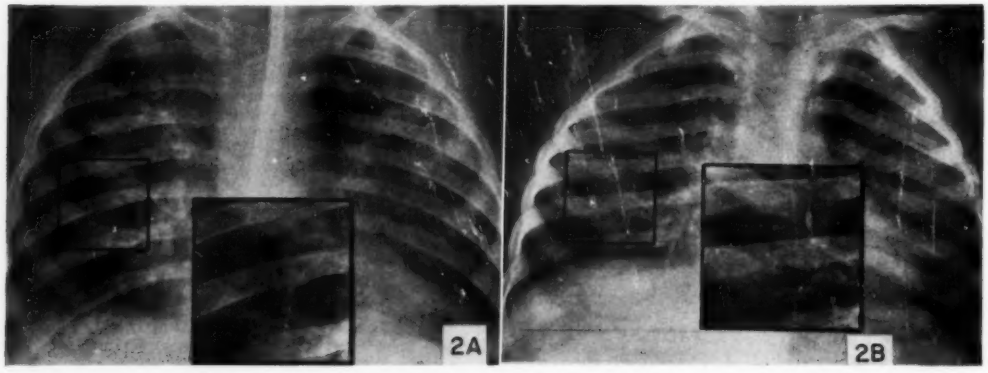


Fig. 2. Probable Shigella Pneumonia
Male, age 2 1/2, very acutely ill for one week before admission. *Shigella alkalescens* cultured from stool and throat. A. Admission chest film showing coarse miliary lesions. B. Two weeks later chest is clear.

per cent of the cases. Pneumonia of a miliary type is encountered almost exclusively in adults. It is accompanied by severe symptoms and has a relatively high mortality. The pulmonary lesions nearly always appear after the skin eruption. The presence at autopsy of varicella-like lesions in the lungs and pleura, with characteristic inclusion bodies, provides evidence that the virus itself causes the pneumonia. Roentgenologically, the miliary nodules are usually fairly large and often confluent. They may regress rather slowly (14–17).

There were 3 such cases in our material. All the patients were adults; all were seriously ill, but recovered. The miliary nodules were unusually numerous and appeared confluent on the admission films, although a few days later they became more discrete. The individual nodules appeared slightly larger than miliary tubercles. In the 2 cases in which follow-up films were available, the lesions were still perceptible more than three weeks after admission (Fig. 3). These cases are being reported in detail (18).

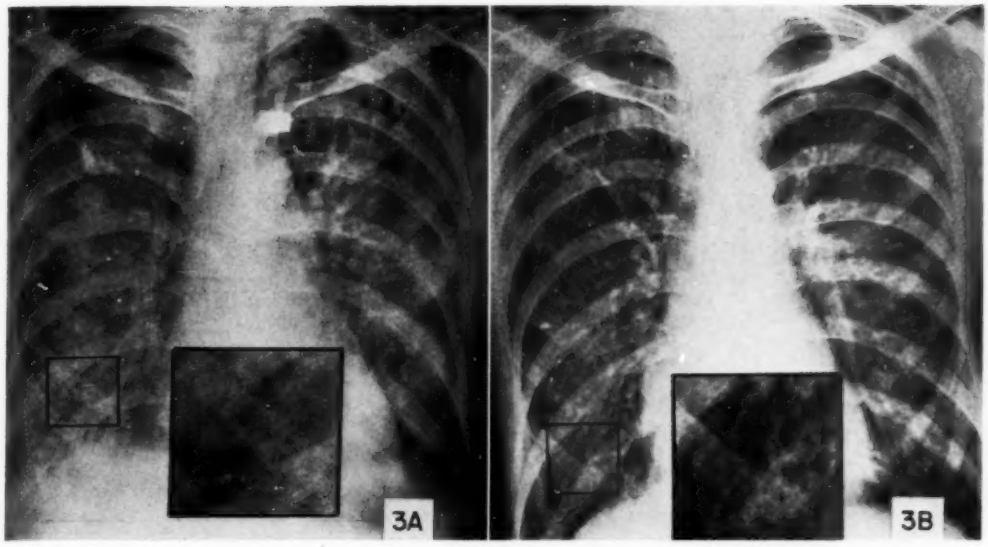


Fig. 3. Chickenpox Pneumonia
White male, age 34. Onset of rash and chest symptoms one week before admission. A. Admission film showing confluent miliary densities. B. Five days later there has been considerable improvement. A film made sixteen days later still showed slight nodulation.

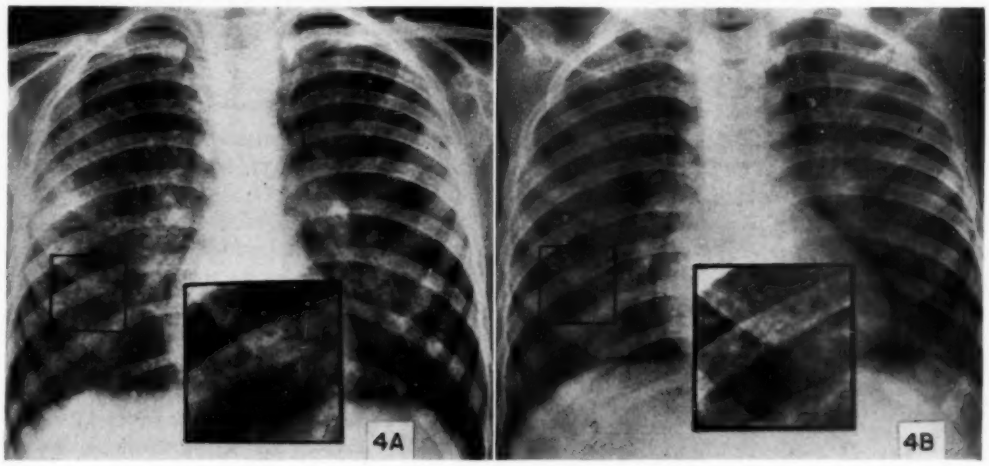


Fig. 4. Measles Pneumonia
White male, age 7. Onset of rash and pulmonary symptoms about two weeks before admission. A. Admission film showing diffuse miliary lesions and moderate hilar enlargement. B. One week later there has been marked clearing.

2. Measles: Miliary pneumonia is occasionally encountered in measles. The pulmonary findings nearly always appear shortly after the rash, but may progress as the rash subsides. The nodules are said to be coarser and sparser than in miliary tuberculosis. The lungs become clear within eight to ten days (5, 9, 12, 19, 20).

Numerous cases of measles with localized areas of pneumonia were recorded in our files, but only 1 case with acute miliary pneumonia (Fig. 4). Another case showed unilateral miliary involvement.

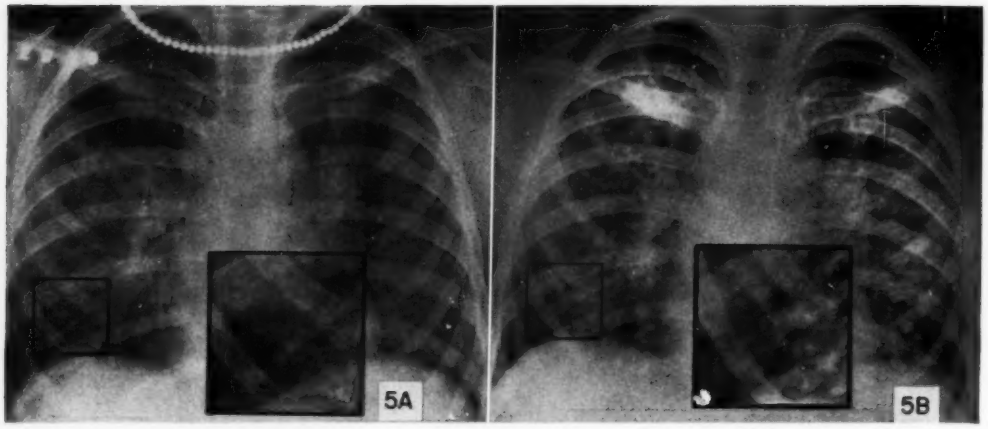


Fig. 5. Probable Histoplasmosis
White female, age 8, acutely ill for ten days before admission. Skin, complement-fixation, and collodion-agglutination tests for histoplasmosis were positive. A. Chest roentgenogram on admission showing faint miliary lesions and lymphadenopathy. B. Film two weeks later showing considerable progression. Films one month later revealed marked regression. Two years later widespread miliary calcifications were present.

3. Influenza: Acute miliary pneumonia was not uncommon in the influenza epidemic of 1918–19. It has also been reported in recent epidemic and sporadic cases (8, 21). There are no examples in our files.

4. Other Virus and Rickettsial Infections: Localized pulmonary infiltrate is the usual finding in ornithosis and Q fever, but occasionally an acute miliary form is encountered (4, 10, 22, 23). Rocky Mountain spotted fever and lymphocytic choriomeningitis are said occasionally to cause a disseminated "interstitial" pneumonia (4). There were no examples of these diseases in our material.

C. Fungus Infections

1. Histoplasmosis: It is difficult to obtain proof of the presence of active histoplasmosis, since the causative organism is not easily demonstrated, and other tests for activity are not readily available. However, a number of proved cases of chronic miliary histoplasmosis have been reported. In addition, an acute form has been occasionally encountered. Roentgenologically, in both the acute and chronic forms there is usually lymph node enlargement. The pulmonary infiltrate regresses very slowly, and eventual calcification is common (24–29).

Two examples of acute miliary histoplasmosis were encountered, both in the files of Children's Hospital. The 2 cases were remarkably alike clinically, serologically, and roentgenologically. Both showed positive complement-fixation reactions of 1:320, which is said to indicate active disease (30). The only significant difference noted between the 2 cases was that during the first two-week period of roentgen observation one showed steady progression (Fig. 5), while the other showed considerable regression.

2. Blastomycosis: Subacute and chronic miliary lesions are common in blastomycosis. An acute form also occurs, usually associated with an acute clinical course and probably representing hematogenous spread. The nodules are said to be coarser and less sharp than miliary tubercles (31–34).

Personal experience with blastomycosis is based on the chest roentgenograms of 16 cases, dating back to 1940, which have been included in a recent report by Schwarz and Baum (35). Of these 16 cases, miliary seeding was present in 7, and other pulmonary abnormalities in 7; a normal chest

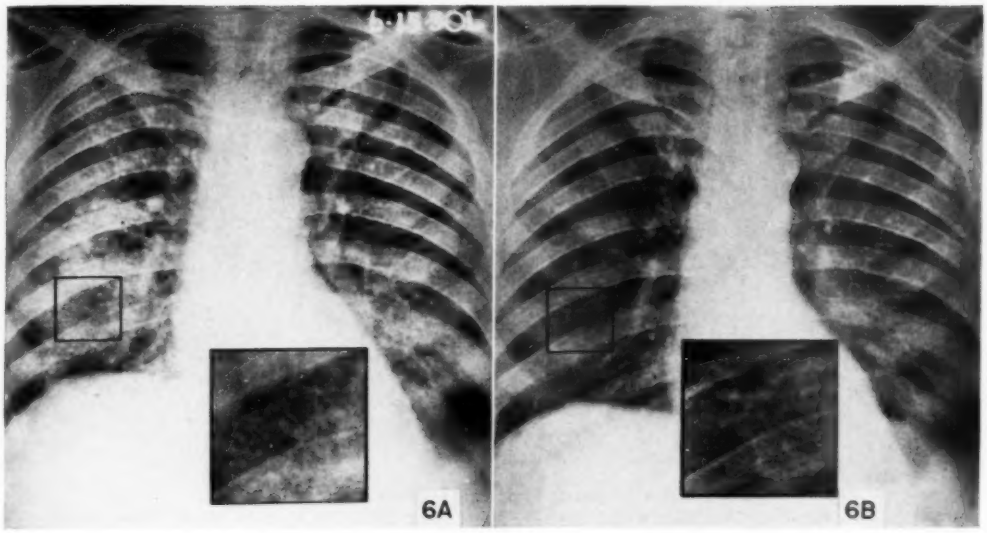


Fig. 6. Blastomycosis
Colored male, age 57, ill for one month. Diagnosis confirmed by culture and autopsy. A. Roentgenogram two weeks after admission, showing extensive miliary lesions. B. Film two weeks later, showing marked improvement. Three months later the roentgenographic appearance was almost identical with A.

roentgenogram was obtained in 2. In only 2 of the 7 cases were the miliary lesions acute. These 2 cases are of special interest because in both there occurred a dramatic improvement in the roentgen findings during the progressively downhill clinical course. The reason for this improvement is not clear, since it could not be correlated with any change in therapy. The lesions reappeared roentgenologically in one of the cases (Fig. 6), and were present at autopsy in the other. We could find no similar roentgen course in cases reported in the literature.

3. Coccidioidomycosis: Localized infiltrate and lymphadenopathy are seen in the chest roentgenogram in the primary form of this disease. In a proportionately small number of cases the serious secondary form develops, the so-called coccidioidal granuloma. Only an occasional case of coccidioidal granuloma shows acute miliary involvement—1 out of 99 cases in one series (36). It is often associated with an acute fatal clinical course. As a rule, the nodules are more indefinite in outline and show a greater tendency to coalesce than in miliary tuberculosis. There is usually mediastinal lymphadenopathy. Rapid progression occurs in the fatal cases, while in patients who recover the lesions may persist for prolonged intervals and ultimately calcify (36–41). No such cases have been recognized in this institution.

4. Other Mycotic Infections: Occasionally actinomycosis may present a miliary picture (37, 42) but no description of its roentgenologic course was encountered. The same applies to aspergillosis (43), moniliasis (36, 43), sporotrichosis (31), and streptotrichosis (37). Terminal acute dissemination has been reported in torulosis (44). Towey *et al.* (45) reported a number of cases of pulmonary infection caused by the spores of a fungus (*Nummularia*) in maple log dust. Nodules 3 to 5 mm. in diameter were found evenly disseminated throughout the lungs except for minimal involvement above the second ribs. Subsequent films showed complete clearing, but the time interval was not stated. No instances of miliary lesions caused by any of these fungi were encountered in our files.

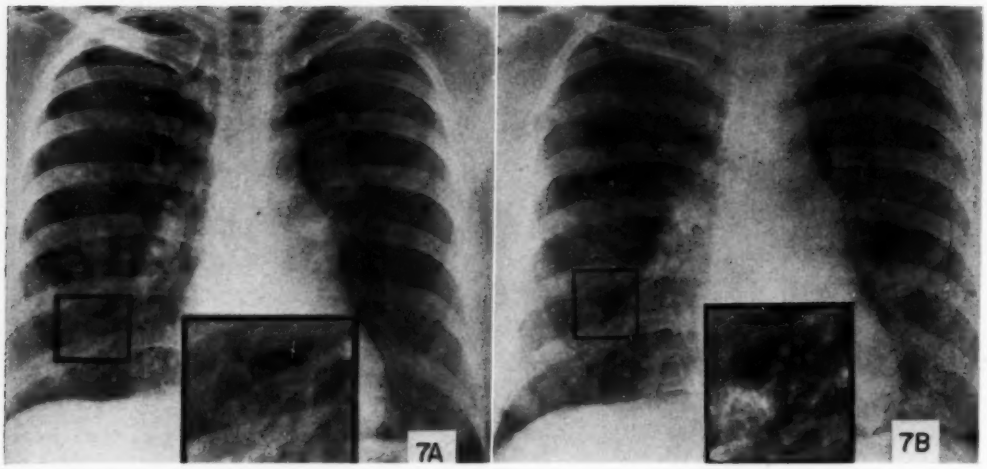


Fig. 7. Acute Diffuse Pneumonia in Chronic Lung Disease
White female, age 24, with history of asthma since childhood. Acute onset two days before admission. A. Admission film: prominent pulmonary arc and exaggerated basal lung markings. B. Film two weeks later showing disseminated miliary lesions. Subsequent films demonstrated rapid clearing.

D. Parasitic Infections

1. Schistosomiasis: Schistosomiasis does not occur on the North American continent but was reported in American troops in the Pacific. The ova are carried via the blood stream to the lungs, where they may incite an acute miliary reaction which clears after a short interval. Cor pulmonale is a common complication of this condition (46–48).

2. Toxoplasmosis: A case of toxoplasmosis in which confluent miliary lesions were found at autopsy has been reported (49). No examples of miliary parasitic disease were encountered in our material.

E. Noxious Inhalations

1. Acute Berylliosis: Chronic exposure to beryllium is a cause of chronic miliary lesions in the lungs. Acute inhalation of beryllium usually results in localized pulmonary infiltrate. However, an acute miliary form, often fatal, may follow brief exposure to high concentrations of this substance. The pulmonary densities appear one to three weeks after the onset of symptoms, and in the non-fatal cases slowly regress for three to four months, leaving no sequelae (12, 50, 51). No cases of acute berylliosis were found in our files.

2. Bagassosis: Bagassosis is an acute febrile illness, sometimes fatal, reported among men handling crushed sugar cane (bagasse). Miliary densities are commonly found in the lungs. Complete resolution usually takes five or six months, but considerable roentgenographic change may occur during intervals as short as two weeks (12, 52). We have had no personal experience with this disease

3. Corrosive Fumes and Gases: This subject will be discussed later under the heading *Bronchiolitis Fibrosa Obliterans.*

F. Diseases with Variable Etiology

1. Acute Diffuse Pneumonia in Chronic Lung Disease: Little has been written concerning the acute diffuse pneumonia encountered in patients suffering from chronic lung disease. Pancoast and Pendergrass (42) stated that during or immediately after an asthmatic attack an intensification of the hilar and trunk shadows developed, often associated with coarse mottling in the lung fields. Cardon *et al.* (53) mentioned diffuse foci of bronchiolitis and bronchopneumonia as occurring in chronic lung disease, but only chronic pulmonary changes were shown in their roentgenograms. Adamson and Beamish

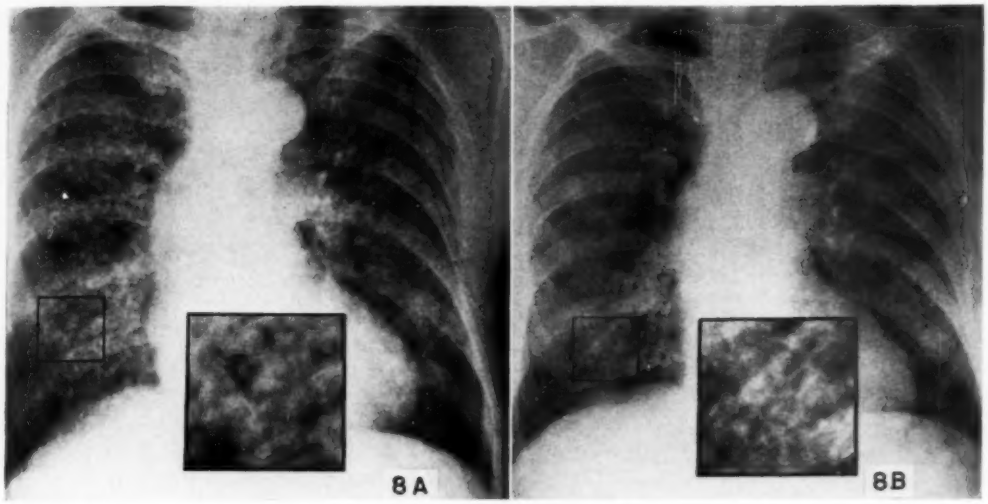


Fig. 8. Bronchiolitis Fibrosa Obliterans
Colored male, age 79, with onset of respiratory symptoms two weeks before admission. A. Admission film showing extensive acute miliary lesions. B. Marked regression ten days later. Further clearing was noted after another ten days, but autopsy the following day showed widespread miliary nodules.

(54) described a widespread bronchopneumonia associated with mild symptoms in asthmatics. Thiberge (55) noted similar findings in asthmatics, and stated that the densities were marked near the hili and lung bases, and less apparent in the apices.

Fifteen cases of acute diffuse pneumonia in chronic lung disease were reviewed and will be the subject of a later report (56). All the patients were admitted with an acute febrile respiratory illness and gave a history of bronchial asthma or other chronic pulmonary disease. None had eosinophilia. In most cases during the acute episode there were enlargement of the hili and a striking diffuse accentuation of the pulmonary markings. Some showed definite miliary nodulation. Complete regression of the acute changes occurred in from one to three weeks (Fig. 7).

2. *Bronchiolitis Fibrosa Obliterans:* The inhalation of noxious gases, especially nitric and sulfuric acid fumes, phosgene and other war gases, and smoke from fires, sometimes results in a specific pathological picture. Severe acute diffuse bronchiolitis develops, followed shortly by an extensive fibrous organization which obliterates the lumina of the bronchioles—hence the term *bronchiolitis fibrosa obliterans*. A similar process has been seen occasionally in fatal cases of measles, whooping cough, scarlet fever, influenza, primary atypical pneumonia, chronic bronchitis, and asthma. At times no underlying disease is apparent. Symptoms depend on the extent of pulmonary involvement. Severe dyspnea and cyanosis are common. Sometimes the symptoms subside for a period of a week or two, only to recur as fibrosis develops and then progress to a fatal termination. Roentgenologically, miliary nodules develop soon after onset but may be obscured by a superimposed pulmonary edema, especially in those cases caused by noxious gases. In non-fatal cases the miliary lesions usually disappear completely in eight or ten days, but occasionally they persist for a prolonged period. The roentgen findings may clear even in cases with a fatal outcome (57–66).

There were 2 proved cases of bronchiolitis fibrosa obliterans in our files, in neither of which was a predisposing disease evident. In both instances the course was progressively downhill, but marked clearing of the miliary nodules occurred before death (Fig. 8). Innumerable miliary lesions were found

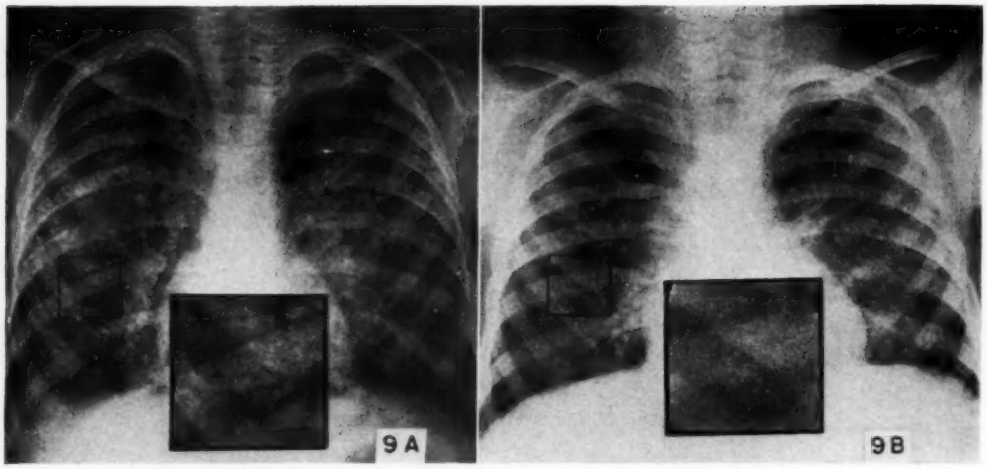


Fig. 9. Loeffler's Syndrome
White male, age 6, with acute respiratory illness. Eosinophilia of 40 per cent. An ascaris was found in the stool. A. Admission film showing extensive confluent miliary pneumonia and hilar enlargement. B. Three weeks later. The lungs are almost completely clear.

at autopsy. They may have been obscured on the antemortem film by the terminal development of pulmonary emphysema.

3. Loeffler's Syndrome: Eosinophilic pneumonia is generally ascribed to an allergic reaction in the lung and may result from a variety of causes. It is usually described as a localized pulmonary infiltration of fleeting character. It may, however, take the form of an acute miliary process (3, 9, 67).

Probably closely related to Loeffler's syndrome is *tropical eosinophilia*, a disease of unknown etiology for which arsphenamine appears to be the specific treatment. Cases have been reported from widely separated geographical areas, including the United States. A miliary appearance, occasionally acute, occurs in this condition. The roentgen findings seldom persist for more than four weeks (67–69).

We have encountered one case of acute miliary Loeffler's pneumonia, reported here through the courtesy of Dr. Warner A. Peck. The patient was acutely ill with respiratory symptoms. An ascaris was recovered from the stool. The lungs cleared completely in about three weeks (Fig. 9).

4. Erythema Nodosum: Recent evidence suggests that the intrathoracic manifestations associated with erythema nodosum are not the result of the underlying disease which is often present (sarcoid, rheumatic fever, tuberculosis, coccidioidomycosis, etc.) but are in some way related to the skin involvement itself. A benign miliary infiltration of the lungs may develop simultaneously with or several months after the mediastinal lymphadenopathy which is so frequent in this condition. Kerley reported a miliary appearance in 8 of 12 cases. Roentgenologically, the pulmonary lesions usually show a subacute or chronic course, but occasionally they disappear in a few weeks (70–72). No case of erythema nodosum with miliary lesions has been identified in our material.

5. Periarteritis Nodosa: Periarteritis nodosa has also been listed as a cause of miliary lesions in the lung, but the rate of change is not stated in the reported cases (5, 8, 10). Several of our cases of periarteritis showed the roentgen findings of acute pulmonary edema of "butterfly" distribution, but none showed miliary densities.

6. Acute Bronchiolitis: Acute bronchiolitis, also called capillary pneumonia and miliary bronchopneumonia, has been fre-

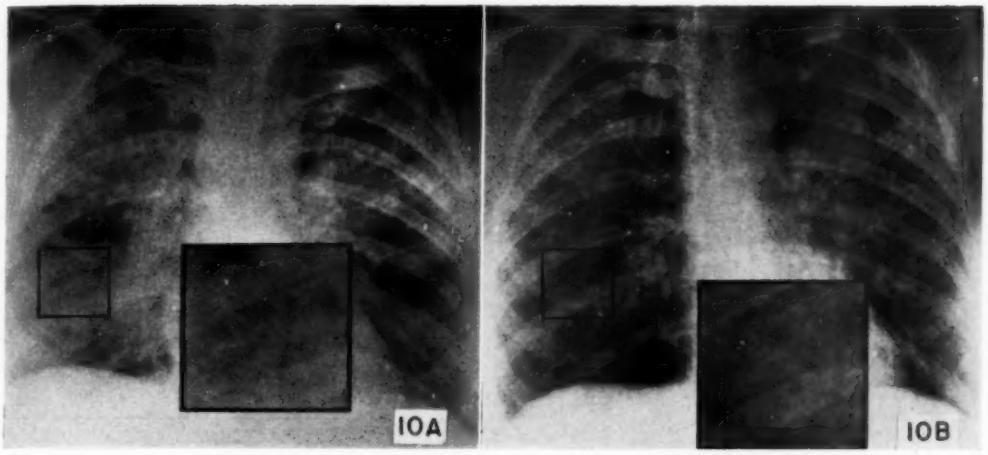


Fig. 10. Primary Atypical Pneumonia
White female, age 47, acutely ill for one week. Cold agglutination positive 1:1280. A. Admission film showing extensive miliary infiltrate with confluence. B. Considerable regression ten days later. Nine days after this the lesions were almost imperceptible.

quently mentioned in the literature, particularly in connection with infants. Dyspnea, cyanosis, and high fever are said to be common, and a fatal outcome has frequently been reported. The etiology is usually not clearly stated, but the condition is most often considered to be a bacterial infection (2, 5, 7, 10, 20, 73, 74). The diagnosis of acute bronchiolitis is often a "wastebasket" for cases of acute miliary disease in which the cause is not apparent. We have preferred to avoid this diagnosis and now classify such cases as *acute miliary pneumonia, etiology unknown*.

7. Other Conditions: Acute miliary lesions have been reported occasionally in pulmonary edema and congestion (1, 8, 75), fat embolism (1, 3), and erythema multiforme (76).

G. Diseases of Uncertain Etiology

1. Primary Atypical Pneumonia of Unknown Etiology: The diffuse miliary form is the least common manifestation of primary atypical pneumonia. It was found in 7 per cent of 135 cases in one series (77). The patients are often extremely ill and may show a rather prolonged clinical course. A fatal outcome is not rare. Bronchiolitis fibrosa obliterans was reported in 4 autopsied cases, 3 of which had shown positive cold agglutination tests (57). The nodules are said to vary from 3 to 5 mm. in diameter The lungs clear in two to four weeks (77–81).

The total number of our cases of primary atypical pneumonia during the period of this study could not be determined accurately. Only 1 case of the miliary form of the disease was found (Fig. 10).

2. Diffuse Miliary Granulomatous Pneumonitis of Unknown Etiology: In 1947, an epidemic of an acute respiratory illness occurred in 12 men who had been engaged in cleaning a large amount of pigeon excreta and other debris from an abandoned water tower in a Cincinnati park. An acute miliary process was demonstrated on chest roentgenograms in all the cases (Fig. 11). Although clinical recovery was fairly rapid, the roentgen changes regressed slowly, and in 4 cases minimal involvement was still present four years later (82, 83). Similar epidemics occurring after exposure to abandoned animal or human habitations have been reported (84–87). The etiology was not established originally, but recently Sabin has stated that, on the basis of complement-fixation tests performed with the yeast phase of the antigen

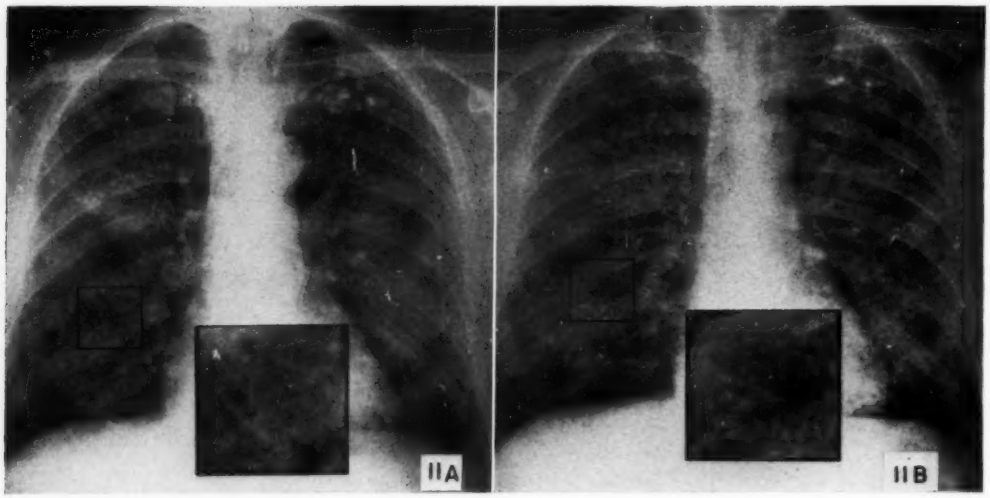


Fig. 11. Diffuse Miliary Granulomatous Pneumonitis
White male, age 53. A. Admission roentgenogram showing faint miliary densities. B. Definite progression one week later. Incomplete regression occurred over the next four years. See text.

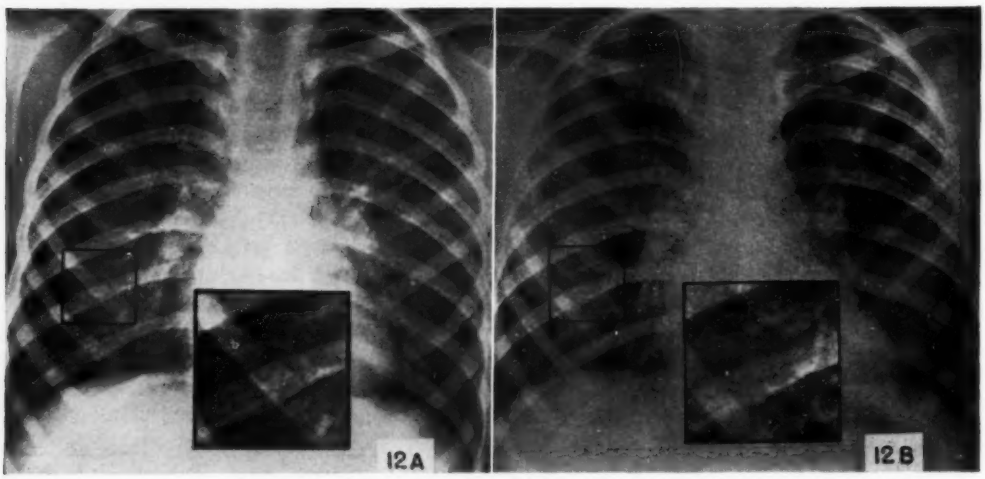


Fig. 12. Probable Infectious Mononucleosis
White male, age 7, acutely ill for two weeks before admission. Hepatosplenomegaly, abnormal mononuclear cells in blood smear, heterophile positive 1:32. A. Admission film showing lymphadenopathy and questionable miliary lesions. B. Distinct miliary appearance two and a half weeks later.

of histoplasma, this condition appears to be attributable to histoplasmosis (88).[3]

3. Infectious Mononucleosis: Generalized "interstitial" involvement of the lungs is said to be common in infectious mononucleosis (4), but only 2 case reports showing an acute miliary pneumonia were found in the literature (89, 90). A similar case was found in the files of Children's Hospital (Fig. 12).

4. Other Conditions: Anspach reported minute pulmonary hemorrhages of un-

[3] After this manuscript was submitted, *Histoplasma capsulatum* was isolated from the soil in the water tower. Additional evidence makes it certain that this organism was the cause of the epidemic.

known origin producing diffuse miliary lesions (91). An acute miliary appearance has also been described in a case of acute diffuse interstitial fibrosis, or Hamman's disease (92, 93).

DISCUSSION

The number of conditions capable of producing acute diffuse miliary lesions in the lungs stands at 40 (Table I), and this list is undoubtedly incomplete. Opinion might differ regarding the location of certain diseases in the classification given in Table I. For example, primary atypical pneumonia and infectious mononucleosis might well be included under virus diseases, even though a specific virus has not been identified. However, it is beyond our purpose to engage in this controversy. Evidence that certain of the conditions listed in the table can produce acute miliary lesions is incomplete. We have indicated these with a question mark.

At first glance the problem of differential diagnosis of acute miliary diseases appears hopeless, but with more thorough analysis it becomes possible to narrow the approach considerably. Table II is a practical attempt in this direction. In this table the extremely rare conditions and the questionable ones are omitted, leaving 16 diseases for consideration. The possibilities may be further decreased by utilizing specific clinical, laboratory, and roentgenologic aids. Thus, in the work-up of the patient with acute miliary lesions, a careful occupational history may give evidence for a diagnosis of acute berylliosis, diffuse miliary granulomatous pneumonitis, or bronchiolitis fibrosa obliterans; a story of bronchial asthma or other chronic pulmonary symptoms strongly favors the presence of the acute diffuse pneumonia which occurs in chronic lung disease. The presence of the skin lesions of chickenpox, measles, erythema nodosum, or blastomycosis clarifies the diagnosis of the pulmonary disease. Study of the blood smear may aid in establishing the diagnosis of Loeffler's pneumonia or infectious mononucleosis. The demonstration of a high

TABLE I: CONDITIONS CAPABLE OF PRODUCING ACUTE DIFFUSE MILIARY LESIONS IN THE LUNG

Bacterial

1. Miliary tuberculosis
2. Staphylococcic infection
3. Streptococcic infection
4. Salmonella infection (?)
5. Shigella infection

Viral and Rickettsial

1. Chickenpox
2. Measles
3. Influenza
4. Ornithosis
5. Q fever
6. Rocky mountain spotted fever (?)
7. Lymphocytic choriomeningitis (?)

Mycotic

1. Histoplasmosis
2. Blastomycosis
3. Coccidioidomycosis
4. Actinomycosis
5. Aspergillosis (?)
6. Moniliasis (?)
7. Sporotrichosis (?)
8. Streptotrichosis (?)
9. Torulosis
10. Nummularia infection

Parasitic

1. Schistosomiasis
2. Toxoplasmosis

Inhalation

1. Acute berylliosis
2. Bagassosis

Variable Etiology

1. Acute diffuse pneumonia in chronic lung disease
2. Bronchiolitis fibrosa obliterans
3. Loeffler's syndrome
4. Erythema nodosum
5. Periarteritis nodosa (?)
6. Pulmonary edema and congestion
7. Fat embolism
8. Erythema multiforme

Uncertain etiology

1. Primary atypical pneumonia
2. Diffuse miliary granulomatous pneumonitis (Feldman and Sabin)*
3. Infectious mononucleosis
4. Miliary hemorrhages in the lung (Anspach)
5. Acute diffuse interstitial fibrosis (Hamman)
6. Acute miliary pneumonia, etiology unknown

* See footnote, page 42.

TABLE II: AIDS IN DIFFERENTIAL DIAGNOSIS OF THE COMMONER TYPES OF ACUTE MILIARY DISEASES

	Disease	Clinical Aids	Laboratory Aids	Roentgenologic Aids
1.	Miliary tuberculosis	.....	.....	Progression
2.	Chickenpox	Skin lesions	.....	Slow regression
3.	Measles	Skin lesions	.....	Rapid regression
4.	Influenza	.....	.....	Rapid regression
5.	Histoplasmosis	.....	Cultures; serological tests; skin test	Very slow regression; lymphadenopathy
6.	Blastomycosis	Skin lesions	Cultures; serological tests; skin test	Usually progression
7.	Coccidioidomycosis	History of residence	Cultures; serological tests; skin test	Slow regression; lymphadenopathy
8.	Acute berylliosis	History of exposure	.....	Slow regression
9.	Acute diffuse pneumonia in chronic lung disease	History of asthma or other chronic lung disease	.....	Rapid regression; hilar enlargement
10.	Bronchiolitis fibrosa obliterans	History of exposure to gas	.....	Usually rapid regression
11.	Loeffler's syndrome	.....	Eosinophilia	Rapid regression
12.	Erythema nodosum	Skin lesions	.....	Usually slow regression; lymphadenopathy
13.	Primary atypical pneumonia	.....	Cold agglutination	Rapid regression
14.	Diffuse miliary granulomatous pneumonitis*	History of exposure to abandoned habitations	.....	Very slow regression
15.	Infectious mononucleosis	.....	Blood smear; heterophile agglutination	Rapid regression; lymphadenopathy
16.	Acute miliary pneumonitis, etiology unknown	.....	.....	.....

* See footnote, page 42.

titer of heterophile agglutinins in the serum is presumptive evidence of infectious mononucleosis; similarly, a high titer of cold agglutinins may be seen in primary atypical pneumonia. Skin tests, complement-fixation and other serological tests, and cultures of the blood, sputum, etc., may give reasonable presumption of one of the mycoses. Lymph node and sternal biopsy may be helpful, and needle biopsy of the liver has been advocated more recently as an aid in the diagnosis of miliary diseases of the lung (94).

All clinical and laboratory studies, however, are sometimes of no avail, as in some instances of miliary tuberculosis, histoplasmosis, bronchiolitis fibrosa obliterans, primary atypical pneumonia, and influenzal pneumonia. Here a study of the roentgen course of the pulmonary lesions may be helpful. In miliary tuberculosis and histoplasmosis the lesions progress fairly rapidly and, in the non-fatal cases, regress very slowly. Progression and regression are usually rapid in bronchiolitis fibrosa obliterans, primary atypical pneumonia, and influenzal pneumonia. The presence or absence of mediastinal and hilar lymphadenopathy has not been as helpful in differential diagnosis as we had anticipated.

Utilizing all of the above aids, there are surprisingly few cases of acute miliary diseases of the lung in which a final diagnosis cannot be made with reasonable certainty. There were only 2 such cases in our material. In a number of other cases, however, particularly those of miliary tuberculosis, two to four weeks elapsed before the diagnosis became evident.

This attempt to delve into the numerous causes of miliary lesions of the lungs has, in some respects, proved disappointing. In the first place, many more causes for acute miliary lesions were found than anticipated, and this seemed to add to the difficulties of the problem. Secondly, it was originally hoped that a study of the characteristics of the individual nodule might give a clue to the diagnosis, but this hope did not materialize. Finally, a pathological-roentgenological correlation, though desirable, could not be made because of insufficient personal material and inadequate or confusing descriptions in the literature.

However, the separation of miliary diseases of the lungs into acute, subacute, and chronic groups has proved advantageous in our hands, not only because it provides a list of conditions to consider when such cases are encountered, but also because it forms the basis of an approach to their differential diagnosis. Some such approach is essential if we are to improve our accuracy in the diagnosis of miliary diseases of the lung.

SUMMARY

1. The roentgen manifestation of diffuse miliary lesions in the lungs occurs in a wide variety of conditions. A specific diagnosis is often difficult or impossible to establish by clinical, laboratory, and roentgenologic means.

2. A classification into acute, subacute, and chronic groups, based on the rate of progression or regression as seen on the roentgenogram, has been useful in the differential diagnosis of such cases.

3. Forty conditions which may cause an acute miliary roentgen appearance are recorded. Of these, 24 are exceedingly rare. Clinical, laboratory, and roentgenologic aids in the differential diagnosis of the remaining 16 diseases are discussed.

4. Illustrative cases are reported, including examples of miliary tuberculosis, Shigella pneumonia, chickenpox pneumonia, measles pneumonia, blastomycosis, histoplasmosis, acute diffuse pneumonia in chronic lung disease, bronchiolitis fibrosa obliterans, diffuse miliary granulomatous pneumonitis of unknown etiology, primary atypical pneumonia, and infectious mononucleosis.

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SUMARIO

Granulias Agudas del Pulmón

En muchos estados distintos obsérvanse lesiones miliares difusas (es decir, lesiones parecidas en tamaño, cantidad y distribución a las de la granulia tuberculosa) que puede revelar la radiografía. En esos casos, el establecimiento de un diagnóstico específico por medio de providencias clínicas, roentgenológicas o de laboratorio resulta a menudo difícil sino imposible.

En el diagnóstico ha resultado útil la clasificación de los hallazgos radiológicos en agudos, subagudos y crónicos conforme a la velocidad de la progresión o regresión de las lesiones. En este trabajo, sólo se consideran las lesiones agudas, es decir, las que manifiestan notable alteración en menos de dos semanas.

Enuméranse 40 estados, 24 de ellos sumamente raros, que provocan roentgenológicamente un aspecto miliar agudo. Los otros 16, con la naturaleza general del cuadro radiológico, son los siguientes: (1) granulia, evolutiva; (2) varicela, lentamente regresiva; (3) sarampión, rápidamente regresiva; (4) influenza, rápidamente regresiva; (5) histoplasmosis, lentísimamente regresiva, con linfadenopatía; (6) blastomicosis, por lo general evolutiva; (7) coccidioidomicosis, lentamente regresiva, con linfadenopatía; (8) beriliosis aguda, lentamente regresiva; (9) neumonía difusa aguda en las neumopatías crónicas, rápidamente regresiva, con linfadenectasia hiliar; (10) bronquiolitis fibrosa obliterante, por lo general rápidamente regresiva; (11) síndrome de Loeffler, rápidamente regresiva; (12) eritema nudoso, por lo general rápidamente regresiva, con linfadenopatía; (13) neumonía atípica primaria, rápidamente regresiva; (14) neumonitis granulomatosa miliar difusa, lentísimamente regresiva; (15) mononucleosis infecciosa, rápidamente regresiva, con linfadenopatía; (16) neumonitis miliar aguda,

etiología desconocida. En algunos de esos estados, pueden indicar el diagnóstico la historia, serorreacciones, y cultivos de la sangre, del esputo, etc.

DISCUSSION

Eugene P. Pendergrass, M.D. (Philadelphia, Penna.): Dr. Felson states that there are more than 80 conditions capable of producing a pattern that simulates that produced by miliary tuberculosis, and in his paper he has discussed those conditions that were available from his own material. He states that his study "in some respects proved disappointing," and he records the reasons why his hopes for better differential diagnosis did not materialize.

Rather than discuss the differential diagnosis or record other acute conditions that produce similar patterns, I would like to confine my remarks to certain terms that are employed in describing roentgen shadows.

The definition of *miliary*, a term used throughout this paper, is "resembling a millet-seed in size (about 2 mm., or 1/12 inch)." I rarely use the term. To me it is applicable only to true millet-seed-sized lesions, which are exceedingly difficult to interpret and evaluate by roentgen examination. These tiny lesions are widely distributed in a symmetrical pattern throughout both lungs. To me, miliary dissemination involves a single discharge of tubercle bacilli into the blood stream. The lesions resulting are all of uniform size. Spleen, kidneys, etc., are usually involved at the same time as the lungs.

In contradistinction to this entity, hematogenous dissemination, which also involves bilateral, symmetrical diffusely distributed pulmonary lesions, is characterized by lesions of unequal size, most of which are visible with no difficulty. The reason why one differentiates between these two entities is one of prognosis. Miliary tuberculosis is a much graver disease than hematogenous tuberculosis. Apparently, successive small showers of tubercle bacilli allow the body to set up its defenses, whereas the single tremendous release of infection into the blood stream is frequently overwhelming.

I have been impressed with our inability to see even larger lesions than miliary lesions on good-quality chest roentgenograms. If that observation is true, would it not be better for us to give up the use of such terms. I have also seen lesions which are small on conventional roentgenograms and are much larger on body section roentgenograms.

Dr. Felson himself calls attention to the difference in the roentgen appearance and that found at autopsy, explaining such differences on the basis of greater thickness of tissue traversed by x-rays, localized emphysema, etc. Superimposed shadows modify the appearance that might be cast by a single shadow. Would it not be better for us as radiologists, especially those of us in teaching institutions, to recognize the limitations of the methods we use? We cannot distinguish the difference between the density or the pattern cast by a single silicotic nodule and that produced by a small exudate of tubercle formation. In other words, we cannot differentiate between so-called nodulation and so-called mottling. In many instances, we cannot differentiate between an infiltrative and an exudative process; yet such terms often are used in radiologic descriptions.

It is my belief that as radiologists we should record our observations in terms of the disease process—for instance—a widespread process involving both lungs, which could be explained by silicosis, tuberculosis, etc. If the process is silicosis, the shadow pattern is probably nodulation; if tuberculosis, the shadow pattern is probably mottling.

Another consideration has to do with the modifying influence of antibiotics and sulfonamides. In addition to a careful history, one should make an effort to learn what medication has been administered. Such information may explain an otherwise baffling shadow pattern. Dr. Felson has re-emphasized that many diseases produce similar roentgen appearances. If the pathologic anatomy of many of the conditions described by him are familiar to us, we are likely to be better consultants than if we attempt to catalogue in our minds that such and such a condition will on occasions produce a given type of shadow.

Partial Obstruction of the Small Intestine

With Special Reference to the Obstructing Segment[1]

JAMES F. MARTIN, M.D.,[2] and HYMER L. FRIEDELL, M.D.

THE ROENTGEN features of obstruction of the small intestine were described by Schwarz (19) in 1911. He employed a bismuth mixture which was administered orally and recorded the following observations in four cases: dilatation of the small intestinal loops, exaggeration of Kerkring's folds, fluid levels capped with gas, and delay in the motor function of the small intestine. The value of the scout film of the abdomen, without the use of a contrast medium, in the diagnosis of intestinal obstruction has been emphasized by Stierlin (21), Marcuse (13), Case (4), Kloiber (10), and others. Less attention has been given to the specific lesions producing partial obstruction of the small bowel and the criteria for their diagnosis by x-ray examination. It is the purpose of this presentation to describe the changes which, in our experience, have been found of value in the study of conditions of this nature.

The complaints in partial obstruction of the small intestine are well established. Briefly, these include crampy abdominal pain unrelieved by food or medication, a change in bowel habit, localized tenderness to palpation, slight swelling of the abdomen, nausea, anorexia, and gaseous eructations. Localized tenderness to palpation is a frequent complaint, and some patients obtain relief of pain following gentle massage of the tender area.

The physical findings in partial obstruction are also well known and need no elaboration here. Palpation may reveal a small area of localized tenderness, and occasionally a small mass may be identified. Dundon (6), in a review of 18 cases of malignant tumor of the small intestine, noted that a mass was palpable in 8 patients. In the cases studied here, tenderness has been a constant observation and has been localized to the point of obstruction irrespective of the nature of the lesion.

ROENTGEN METHODS OF STUDY

Morse and Cole (14) described a standard technic of examination of the small intestine, employing an oral barium mixture and serial film studies. Subsequent modifications have produced many variations in their method. Golden (8) uses 120 gm. of barium sulfate in 4 to 5 oz. of normal saline, obtaining films at half-hour intervals for five to six hours, with fluoroscopy and spot radiographs as indicated for the study of suspected anatomical variations. Weber and Kirklin (25) use equal parts of barium and water, with frequent roentgenoscopic and spot-film studies. They permit food and water as soon as the stomach is empty, to stimulate peristalsis and to accelerate the passage of barium through the small intestine. Other variations in technic have been described by Åkerlund (2), Pansdorf (15), and Hodges *et al.* (9). Recently, Weintraub and Williams (27) described a rapid method of small bowel examination employing a mixture of barium and cold normal saline in order to decrease the transit time.

With the advent of stomach and small intestinal tubes, a variety of technics was developed. Schatzki (18) in 1943 re-emphasized the "small bowel enema," with injection of a copious volume of a thin barium mixture through a tube, the tip of which was located in the duodenum. The Miller-Abbott tube has been widely utilized both for therapeutic purposes and as a diagnostic aid. It permits decompression of the small intestine (1)

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and study of the obstructing segment by the injection of a thin barium mixture near the obstructing lesion. Double contrast methods using specially constructed tubes through which a barium mixture and air are injected have been described by Pribram and Kleiber (16) and more recently by Friedman and Rigler (7).

It is not our purpose to try to evaluate all of these procedures, but rather to emphasize that a routine oral method may be quite adequate in many instances without resorting to more elaborate and time-consuming studies. Our usual procedure is to have the patient drink 200 c.c. of a moderately thin barium and water mixture under fluoroscopic observation. The esophagus, stomach, and duodenum are examined immediately, and the rate of gastric emptying observed at this time will assist in determining the intervals at which film studies are best obtained. Roentgenograms are routinely made at thirty and sixty minutes after the initial ingestion of the barium mixture. Thereafter, they are obtained at hourly intervals until all of the mixture has reached the cecum. Fluoroscopy and spot radiographs are employed for the study of suspected abnormalities. It is routine to observe and obtain spot radiographs of the terminal ileum.

The procedure described in the preceding paragraph has the disadvantage of being time-consuming and requiring numerous roentgenograms, but it obviates the discomfort associated with stomach and intestinal tubes and permits a more accurate evaluation of the motility of the small intestine. Food and cold water are permitted as soon as the stomach is completely empty of the barium mixture, and in many instances this has reduced the entire time interval for the examination without seriously interfering with the continuity of the barium within the small intestine. It has been our experience that this method permits adequate visualization of most lesions producing partial obstruction, if fluoroscopy and spot radiographs are extensively utilized.

ROENTGEN OBSERVATIONS OF THE SEGMENT PROXIMAL TO THE POINT OF PARTIAL OBSTRUCTION

1. *Gas:* Case (4), Weil (26), and Wangensteen and Lynch (23) are inclined to believe that, except in infants and the aged, gas is never seen in the normal small intestine in sufficient quantities to be recognized on the roentgenogram. According to Swenson and Hibbard (22), small amounts of gas are occasionally seen which do not denote actual obstruction of surgical importance. We believe, however, that small localized persistent accumulations of gas may be significant and, when found, call for further study with the barium meal. They are especially important when the clinical history is that of partial obstruction. The separation of gas from the liquid content is usually an indication of localized abnormality and is probably secondary to stasis, decreased absorption, or increased secretion by the thickened mucosa proximal to the point of obstruction (22).

The shadow of the normal barium-filled small intestine is dense, and the column is continuous, with smooth marginal indentations and varying contours. The characteristic feathery pattern of the jejunum and the smooth shallow serrations of the ileum have long been recognized by radiologists. In partial obstruction, the admixture of barium, gas, and fluid gives a rather characteristic mottled pattern which is readily recognized on the roentgenogram. Occasionally, however, there is no detectable separation of gas from fluid in the proximal segment, and the intestinal contents remain liquid. The roentgen findings may then consist of an unusually dense barium column proximal to the lesion, while the pattern distal to the obstructing segment is normal.

The localized accumulation of gas must be differentiated from generalized gaseous distention of the intestine. This may occur in metabolic, vascular, endocrine, and neurogenic disorders or may represent a reflex ileus. The clinical history and the

physical examination are of utmost importance in the differential diagnosis and must be relied upon to aid in excluding these abnormalities.

2. *Caliber:* The transverse diameter of the normal barium-filled jejunum is 2.0 to 3.0 cm. and that of the ileum is 1.5 to 2.5 cm. (8). These measurements increase as the degree of partial obstruction progresses, so that frequently the diagnosis is obvious on a scout film. Lesser degrees of obstruction may, however, produce little or no dilatation of the proximal segment. This has been found to be especially true in cases with peritoneal adhesions, in which this feature was of no aid in the diagnosis. It is probable that some degree of hypertrophy occurs in the muscularis which adequately compensates for the abnormality.

3. *Mucosal Pattern:* The normal jejunum has deep, coarse, marginal indentations and heavy, reticulated, irregular horizontal folds. The ileum is predominantly tubular in appearance, with shallow marginal indentations and thin regular transverse folds. The character of the mucosal pattern frequently suggests the presence of a partial obstruction, for hypertrophy of the muscular wall and thickening of the mucosal folds occur proximal to the point of obstruction. This produces an increase in the distance between adjacent folds and a decrease in their depth. This may be especially striking in the jejunum, where the normal marginal indentations may reach as much as 3.5 mm. In the ileum, the hypertrophy is manifest as a smoothly marginated segment in which the transverse folds are either very thin or completely obliterated.

4. *Transit Time:* Golden (8) has studied the transit time of a barium mixture through the small intestine and indicates that the stomach should be empty at the end of four hours and that the head of the column should reach the cecum in two to four hours. These latter intervals, however, may be altered if emptying of the stomach is delayed. The degree of obstruction governs the prolongation of the transit time, obstructions of minor degree causing no apparent delay. A faint separation of the tail of the barium column has been a common finding (8) in the normal small intestine but becomes significant when there is a definite trailing segment of normal or increased barium density. Occasionally, discontinuity or fragmentation of the tail of the column may be a leading observation in lesser degrees of partial obstruction. This emphasizes the importance of following all of the barium through the small intestine and observing the continuity of the column. Obstruction of a greater degree produces a definite prolongation of the transit time of the barium meal.

5. *Segmentation:* Segmentation, or discontinuity of the barium column, has been observed in many diseases involving the small intestine. These include allergy (5), deficiency (12) and anxiety states, parasitic infestations (11), tumors, and inflammatory lesions. The systemic disorders are usually associated with multiple localized inconstant areas of spasm which divide the column into many segments. In the presence of partial obstruction, these localized accumulations of barium are almost always constant and do not change in position or contour on palpation. Localized tenderness is noted on palpation over the involved loops.

6. *Position and Mobility of the Segments:* The position of the loops of small intestine within the abdomen is variable and is related to the degree of rotation of the mesentery in fetal life. In general, the jejunum is located in the left upper and mid abdomen, while the ileum occupies the pelvis and the right side of the abdomen. The position of these loops may be altered by congenital developmental defects, intra-abdominal masses, adhesions, trauma, operative procedures, hernia, exudate, hemorrhage, and peritoneal fluid. The mobility of adjacent loops assumes importance in determining the occurrence of fixation, as in the presence of adhesions and intra-abdominal masses. The relationship of adjacent segments, as determined by pal-

pation at fluoroscopy, gives an indication of the extent of the disease and is particularly important in the recognition of peritoneal and omental adhesions where there may be little else to identify the site of the lesion.

7. *Peristalsis:* Fluoroscopic observation of the segments proximal to the point of partial obstruction reveals a localized increase in peristaltic activity. The narrowed lumen may permit only a small portion of the barium to pass through with each wave, so that a residue remains proximal to the obstructing segment. This creates a "to-and-fro" type of peristalsis, and the depth of the contractions may be increased. The peristaltic activity distal to the obstruction is usually normal or slightly diminished.

It is of utmost importance to observe the patients carefully and to question them regarding symptoms during the fluoroscopic study of peristalsis through the narrowed segment. Cramp-like pain is a common experience as the wave approaches the obstruction, with relief after it has passed beyond. This has been a constant finding and has served to verify the site of the lesion. Localized tenderness to palpation has also been a constant observation and further aids the observer in identifying the site of the obstruction.

THE OBSTRUCTING SEGMENT

The study of the defects at the site of partial obstruction requires detailed fluoroscopy and multiple spot radiographs. The obstructing segment can frequently be identified and may present characteristic features which aid in the diagnosis. It should be observed, however, that the character of the deformities may not be specific and the true nature of the lesion cannot be established. It seems useful to review the features observed in various lesions which cause partial obstruction. The following case presentations illustrate six lesions of varied nature with special attention to the mucosal pattern of the obstructing segment, its general contour and deformity, and its behavior during peristalsis.

CASE I: *Solitary Omental Adhesion.* A 38-year-old white female complained of cramp-like intermittent generalized abdominal pain and a slight increase in the size of the abdomen for eighteen months prior to admission. She gave no history of vomiting, tarry stools, or tenesmus, but had experienced slight nausea and constipation. The pain occurred at irregular intervals without relationship to meals or medication. There had been no previous laparotomy.

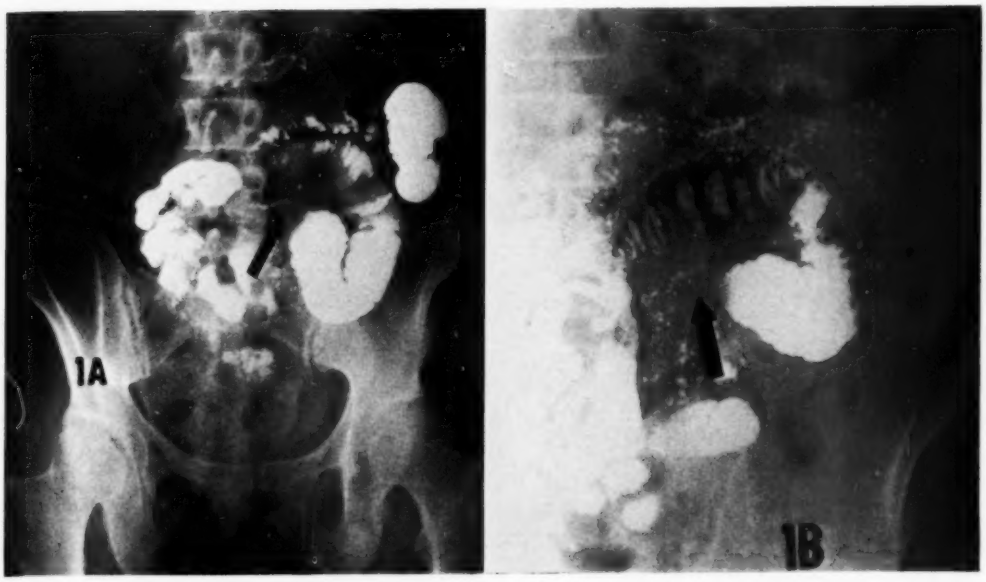
Physical examination revealed slight distention of the lower abdomen with borborygmi in the left para-umbilical region, slight spasm of the left rectus muscle, and an area of localized tenderness just to the right of the umbilicus. The roentgen findings are shown in Figure 1.

Surgical exploration revealed a distended loop of jejunum with collapsed intestine distal to a point of obstruction. A finger-like projection of omentum was firmly adherent to a small nodule in the mesenteric attachment of the intestine and encircled a portion of the latter, producing a partial obstruction. Several small filmy adhesions were present throughout the peritoneal cavity. The segment was resected and an end-to-end anastomosis was performed. Microscopic examination showed marked thickening and edema with acute and chronic inflammation of the intestinal wall, chronic organizing peritonitis, and chronic organizing inflammation of fibro-adipose tissue.

CASE II: *Regional Ileitis.* A 64-year-old white male was admitted to the hospital in January 1949, complaining of intermittent cramp-like abdominal pain, nausea, diarrhea, and vomiting, of two months duration. For several months prior to admission he had noticed the gradual appearance of a palpable mass in the right mid and lower abdomen, and its disappearance following vomiting. The pain began about two hours after meals and lasted eight to twelve hours. Five to six liquid stools were passed daily and were normal in color. A laparotomy had been performed in October 1948 for intestinal obstruction, at which time multiple adhesions were found in the distal ileum.

The physical examination disclosed slight generalized abdominal distention and slight tenderness to deep palpation in the right lower quadrant. Well healed right inguinal and left rectus scars were present. The erythrocyte count was normal, and the stools were negative for occult blood. The roentgen study is illustrated by Figure 2.

At surgery, a segment of terminal ileum 20 cm. in length was found to be thickened, constricted, and doubled upon itself by many adhesions. The intestine proximal to the obstruction was thickened and dilated. The microscopic sections revealed chronic inflammation consistent with regional ileitis.



CASE III: *Meckel's Diverticulum with Invagination into the Ileum and Partial Obstruction.* A 31-year-old white male complained of recurrent attacks of cramp-like upper abdominal pain, nausea, vomiting and occasional bouts of diarrhea, of four years duration. The attacks were precipitated by food, and medical therapy had little effect in controlling the pain. The patient experienced epigastric distress daily, with occasional severe incapacitating paroxysms. A right inguinal herniorrhaphy and an appendectomy had been performed four years prior to admission.

Physical examination revealed localized tenderness to direct palpation in the right mid abdomen. Borborygmus was noted, especially on the right side. A well healed right inguinal scar was present. The roentgen examination is represented by Figure 3.

Surgical exploration revealed a sausage-shaped mass within the lumen of the ileum in the right lower quadrant, producing a partial obstruction. This proved to be a Meckel's diverticulum 7.5 cm. in length and 2 cm. in width, covered by a pinkish gray mucosa. When the mass was opened longitudinally, the fat-filled lumen was found to be continuous with the fatty tissue of the mesentery and the smooth glistening lumen to be continuous with the serosal surface of the bowel.

CASE IV: *Chronic Ileitis and Peri-ileitis.* A 42-year-old white male complained of recurrent episodes of relatively painless spasm of the intestine of twenty years duration and mild constipation. Ingestion of food precipitated the attacks and no relief was obtained from medication. During the year prior to admission, the patient had three

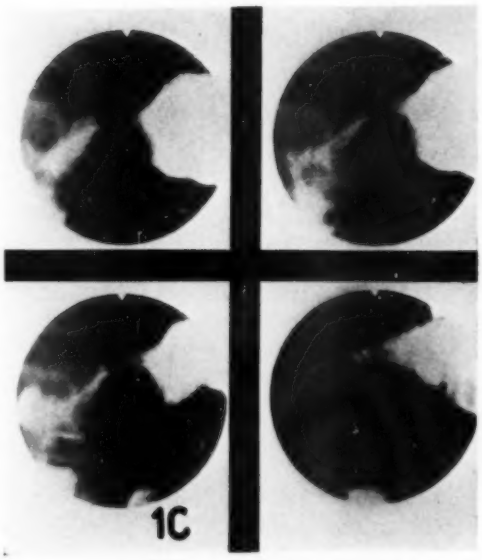
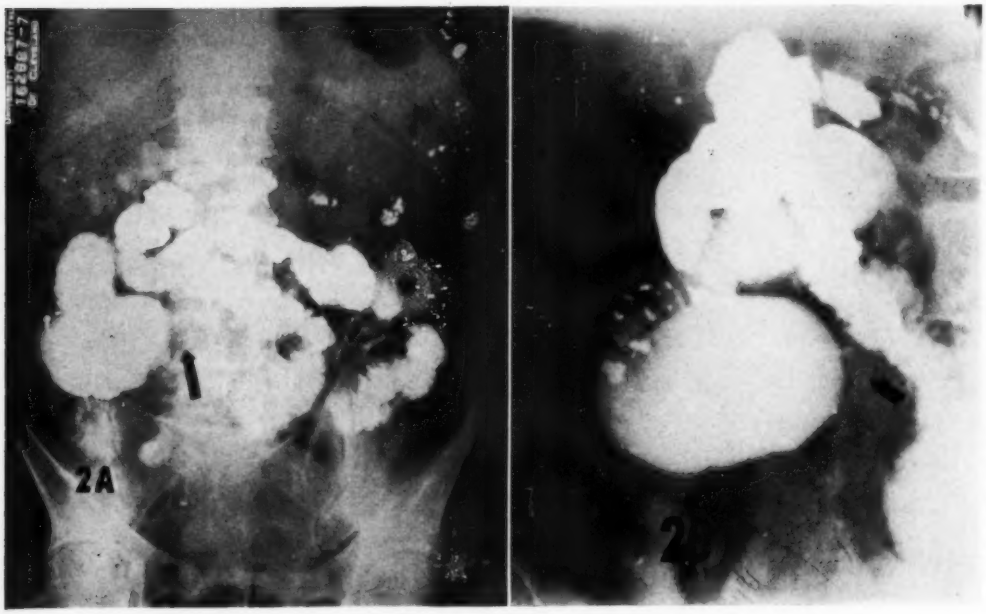


Fig. 1. Case I: Solitary finger-like omental adhesion producing a partial obstruction.

A. Routine anteroposterior roentgenogram made three hours after the ingestion of barium, demonstrating abnormal gas within the lumen of the small intestine, slight dilatation, and slight delay in the transit of the barium.

B. Spot roentgenogram showing slight separation of the tail of barium column and the general contour of the obstructing lesion.

C. Spot roentgenograms demonstrating the behavior of the obstructing segment during peristalsis. The mucosa is intact but distorted.



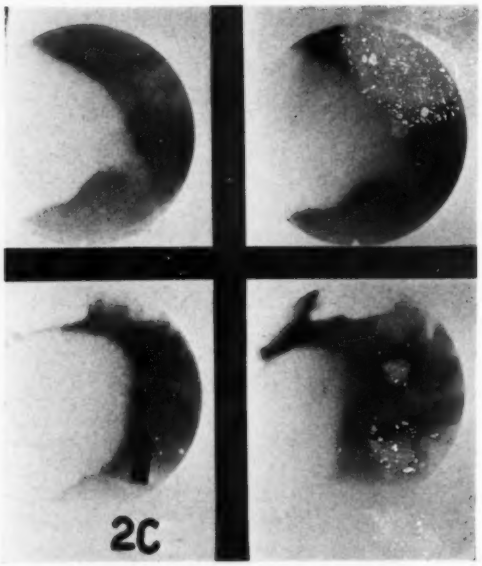


Fig. 2. Case II: Regional ileitis with partial obstruction.
A. Roentgenogram of the abdomen made six hours after the ingestion of barium, demonstrating a marked prolongation of the transit time, dilatation and thickening of a segment of ileum, without detectable separation of gas from the liquid contents.
B. Spot roentgenogram showing the location and contour of the obstructing segment in the ileum.
C. A series of spot roentgenograms demonstrating the behavior of the segment during peristalsis and the destruction of the mucosa.

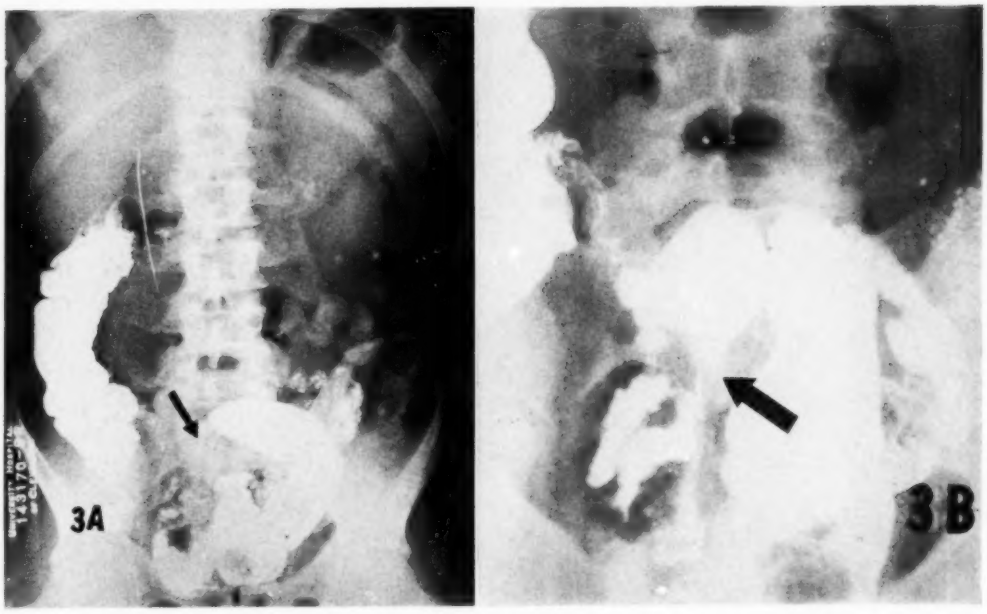
severe bouts which were characterized by constant left lower quadrant pain, nausea, and vomiting.

Physical examination revealed slight generalized distention of the abdomen but no tenderness or masses. Rectal examination disclosed a palpable, stony-hard, slightly tender mass just above the prostate gland, which was fixed and measured about 10 cm. in diameter. The erythrocyte count was normal. The roentgen examination is represented by Figure 4.

Surgical exploration revealed a dilated and thickened loop of distal ileum leading into an inflammatory mass deep in the pelvis. This was adherent to the posterior wall of the bladder and surrounded a segment of ileum, producing a partial obstruction. The distal 10 inches of ileum was resected and an ileocecal anastomosis was performed. The microscopic diagnosis was chronic ileitis and peri-ileitis, chronic peri-appendicitis, organizing thrombosis of the mesenteric lymphatics, and marked lymphedema, especially in the submucosa.

CASE V: *Carcinoid of Jejunum with Intussusception.* A 47-year-old colored female was admitted to the hospital with a history of nausea, vomiting, and intermittent epigastric pain of ten months duration. The symptoms persisted despite medical therapy and became more marked one month prior to admission, when tarry stools were noted.

Physical examination revealed a large, palpable, firm, smooth mass extending from the pelvis to the umbilicus. On pelvic examination, the mass appeared to be attached to the uterus and was thought to represent fibromyomata. Sigmoidoscopy dis-



closed a small rectal polyp 2 cm. in diameter, which on microscopic examination proved to be benign. Laboratory studies showed anemia, with a hemoglobin of 35 per cent and an erythrocyte count of 3,000,000. On several occasions, the stools were tarry black in color with positive benzidine and guaiac reactions.

A small intestinal series on Jan. 9, 1947, revealed no evidence of obstruction. A repeat examination on Jan. 14, 1947 (Fig. 5A and B) showed several dilated gas-containing loops of distal jejunum in the left mid and upper jejunum, with marked delay in transit time. On Feb. 10, 1947, the contour of the lesion appeared changed and the obstruction was more marked (Fig. 5A′ and B′). In retrospect, the inability to demonstrate a constant defect and the variability of the contours observed suggest that obstruction was produced by a process which was also inconstant and variable, such as an intussusception.

At operation, an intussusception was identified in the distal ileum. A firm mass, 2 × 2 × 3 cm., was palpated through the wall of the small intestine and was the leading part. There were three large nodes at the base of the mesentery. Six inches proximal to the mass was a soft, sessile, light gray mass at the mesenteric border. The segment was resected and the microscopic examination revealed a malignant carcinoid of the small intestine, with metastases to the mesenteric lymph nodes, and marked lymphedema and chronic inflammation of the small intestine with hypertrophy of the muscular wall proximal to the intussusception.

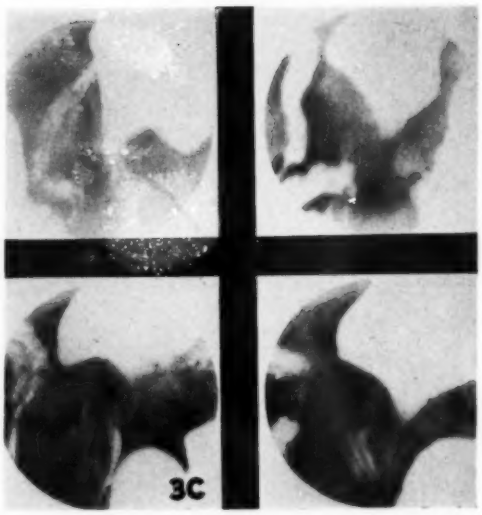
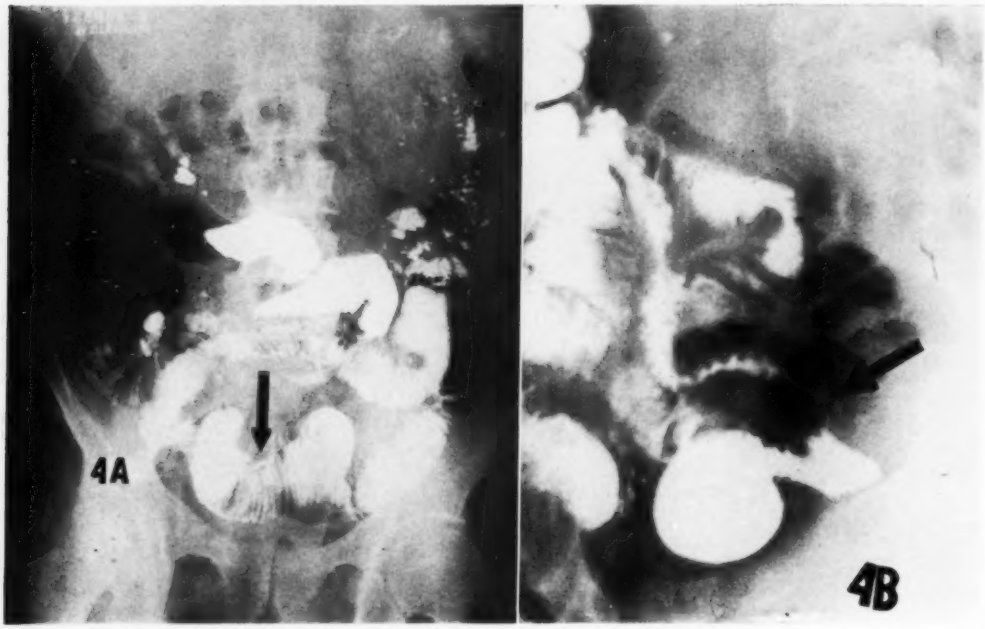


Fig. 3. Case III: Meckel's diverticulum with invagination into the ileum and partial obstruction.

A. Roentgenogram made seven hours after the ingestion of barium, demonstrating prolongation of the transit time and slight widening of a segment of distal ileum. There is no separation of gas from the liquid contents of the small intestine.

B. Spot roentgenogram showing a smooth asymmetrical defect in the distal ileum about 25 cm. from the ileocecal junction.

C. Spot roentgenograms demonstrating the behavior of the obstructing segment during peristalsis and the distorted but intact mucosa.



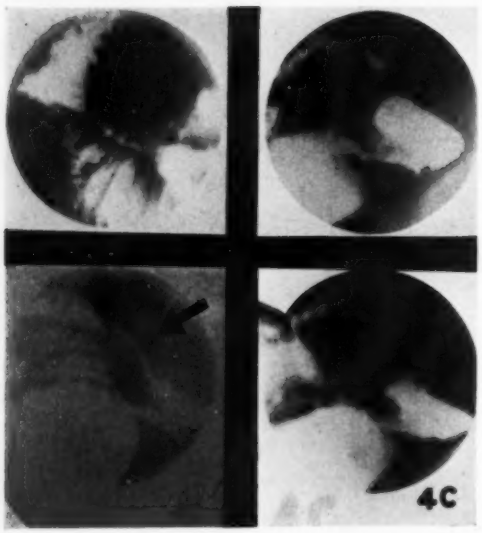


Fig. 4. Case IV: Chronic ileitis and peri-ileitis.
A. Roentgenogram made seven hours after the ingestion of barium, showing dilated gas-containing loops of distal ileum with coarsened mucosal folds and prolongation of the transit time.
B. Spot roentgenogram demonstrating the contour of the obstruction in the distal ileum, about 15 cm. proximal to the ileocecal junction.
C. Spot roentgenograms of the obstructing segment demonstrating the behavior during peristalsis and the distortion of the mucosa.

CASE VI: *Carcinoma of the Ovary with Peritoneal Metastases.* A white female, 69 years of age, was admitted to the hospital in June 1948, complaining of intermittent generalized abdominal pain, nausea, and vomiting of one month duration. A right oophorectomy had been performed in 1947, at which time a large cyst of the right ovary was ruptured during the course of its removal and some of the semiliquid contents spilled into the abdominal cavity. The microscopic diagnosis was papilliferous cystadenocarcinoma of the ovary.

Physical examination revealed slight generalized abdominal distention with tenderness to palpation in the lower mid abdomen. There was a slight anemia. Figure 6 represents the roentgen examination.

Surgical exploration revealed widespread neoplastic implants throughout the peritoneal cavity, involving the surfaces of the abdominal viscera and producing partial obstruction in the distal jejunum. An anastomosis was performed to short-circuit the large mass, in which both small and large intestine were incorporated, and to relieve the obstruction. The patient died on her 134th hospital day.

Autopsy showed poorly differentiated papilliferous cystadenocarcinoma of the right ovary with widespread metastases to the peritoneum, liver, pancreas, ureters, and to the serosa and submucosa of the stomach, jejunum, ileum, and colon, producing focal complete obstruction of the ileum and of the ascending and transverse colon. There was invasion of the muscularis externa of the gastro-

Fig. 5. Case V: Malignant carcinoid of the jejunum with intussusception.

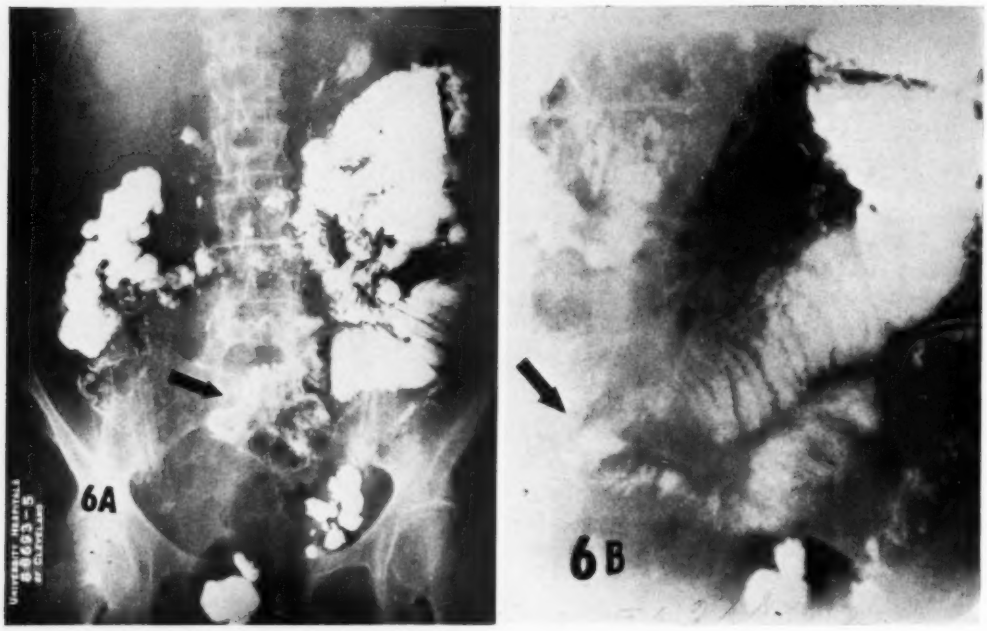
A. A small intestinal series of Jan. 14, 1947, revealed marked delay in the transit of the barium. The roentgenogram shows the appearance five hours after the ingestion of the barium, with several dilated, gas-containing loops of distal jejunum in the left upper abdomen.

B. Spot radiograph of the obstructing segment, Jan. 14, 1947. Barium could be expressed beyond the point of obstruction, but the contour and detail could not be clearly demonstrated.

A′. A repeat small intestinal series, Feb. 10, 1947, again revealed prolongation of the transit of the barium. The loops proximal to the point of obstruction are slightly dilated.

B′. Spot roentgenogram at the site of obstruction, Feb. 10, 1947. The mucosal folds are flattened and the obstructing segment was not well visualized.

Comment: A small intestinal series of Jan. 7, 1947, was normal in appearance. The two studies presented reveal an inconstant and varying deformity at the site of obstruction suggesting varying degrees of intussusception.



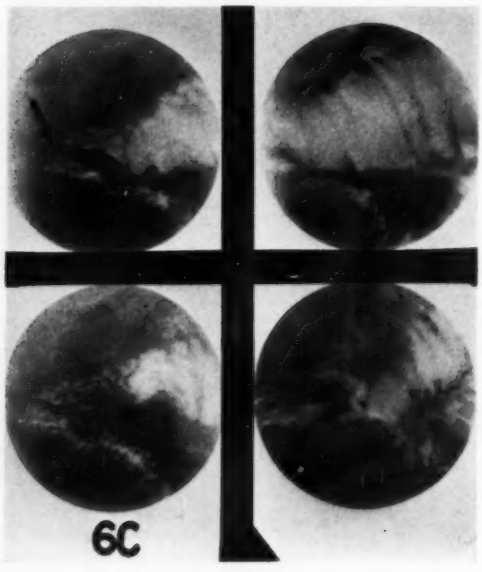


Fig. 6. Case VI: Carcinoma of the ovary with peritoneal metastases.

A. Anteroposterior roentgenogram of the abdomen made four hours after the ingestion of barium, demonstrating prolongation of the transit of the barium and dilated gas-containing loops of distal ileum.

B. Spot radiograph showing the general contour and "kinking" at the site of the partial obstruction, and coarsening of the mucosa in the proximal segment.

C. Spot radiographs demonstrating the behavior of the obstructing segment during peristalsis. The mucosa is intact but slightly distorted.

intestinal tract, but the mucosa was not involved. The serosal surfaces were intimately adherent, with masses of tumor and fibrinous adhesions.

The acute intrinsic inflammatory lesions in the small intestine usually do not produce obstruction unless they are associated with a localized process such as an appendiceal abscess or with the formation of adhesions. The subacute and chronic intrinsic inflammatory lesions (Cases II and IV) may produce varying degrees of stenosis and partial obstruction. The obstructing segments may be annular or asymmetrical, solitary or multiple, and vary from 2 to 10 cm. or more in length. As a general rule, the inflammatory segments are longer than those associated with primary tumor. The mucosal pattern is markedly distorted or destroyed, and the margins of the defect are irregularly demarcated, frayed, and serrated (12). The intestinal wall may be thickened so that peristalsis is diminished or absent. There is localized tenderness to palpation, and the

mobility of the segment may or may not be affected. As the lesion heals and fibrosis develops, a short irregular segment of stenosis may be identified. Fixation of the segment occurs when the inflammation extends to involve the peritoneal surface and adjacent structures (3).

Peritoneal and omental adhesions occur as a result of inflammation and irritation. Solitary peritoneal adhesions may produce a narrowing or kinking of the loops by close approximation of adjacent intestinal walls or they may be thread-like and several centimeters in length, producing a "kink" (8) in one or more segments. Peristalsis passes through the intestine but the activity may be diminished and asymmetrical at the site of the partial obstruction. The solitary omental adhesion (Case I) may produce a unilateral asymmetrical curvilinear defect which is relatively short. Multiple peritoneal adhesions may involve several separate segments (20) or incorporate many adjacent loops, producing a large mass of barium-filled small intestine in which the contour of the individual segments is obscured. Peristalsis can be identified in the margins of the intestine about the periphery of the mass but is diminished and is usually associated with cramp-like pain. Separation of the individual segments by palpation is frequently impossible. The mucosa is intact, with smooth margins, but the folds may be distorted and elongated.

Benign tumors of the small intestine are usually difficult to diagnose, and the majority are identified only at autopsy. They may be of such small dimensions that the defects are overlooked, or may produce no secondary changes by which they can be recognized. They are manifest as constant round or oval filling defects either within the lumen or along the margin of the barium column. The mucosa is distorted and irregular at the site of attachment. The tumor may produce acute pain when it leads an intussusception, and the deformity at the site of obstruction may be quite bizarre. The mucosal pattern may be flattened and the margins smooth. The contour may change during the examination and occasionally the intussusception may be reduced.

The primary malignant neoplasm of the small intestine is frequently annular (24) and produces a short, sharply demarcated segment. The mucosa is destroyed and the margins are irregular and serrated. There is no peristalsis through the obstructing segment, and the lesion may be freely movable. Varying degrees of fixation may be observed, with extension into the mesentery of adjacent loops. Fungating or polypoid lesions may be asymmetrical and peristaltic waves may be observed passing through the uninvolved portions of the intestinal wall. These tumors may also produce intussusception (Case V), making study of the lesion difficult.

Lymphosarcoma leads to several different types of deformity and is not always an obstructing lesion. The localized form usually causes a short, asymmetrical area of stenosis in which the mucosal folds are either destroyed or edematous and distorted. Peristaltic activity is diminished or absent because of the varying degrees of submucosal infiltration and mesenteric involvement. Occasionally, a slightly dilated segment, measuring up to 10 or 15 cm. in length, may be identified (6). The generalized form may involve many segments of the intestine, with multiple marginal filling defects and irregular, asymmetrical areas of stenosis throughout. These may be continuous with loops in which the margins are smooth and flattened, and in which the lumen is either normal or slightly narrowed. The segments may be slightly separated because of the thickening of the mesentery. Palpation reveals thickening of the intestinal wall, and there is some difficulty in compressing the lumen. Intussusception may occur. Multiple lesions involving the stomach and small intestine, when identified, may be a distinguishing feature.

Metastatic tumors (Case VI) may deform the walls of the small intestine either by local invasion, direct extension, or by multiple peritoneal implants. Direct ex-

TYPE OF LESION	MUCOSAL PATTERN	LENGTH OF LESION	CONTOUR OF LESION	PERISTALSIS	POSITION IN ABDOMEN
INFLAMMATORY (Sub-acute and chronic)	Edematous occasionally destroyed	Wide variation	Asymmetrical and narrowed	Diminished or absent	Non-specific
BENIGN TUMORS	Unaltered except at base of lesion Intussusception	Intraluminal filling defect	Sharply demarcated, round or oval	Unaltered, diminished with intussusception	Non-specific
CARCINOMA (Primary malignant tumors)	Destroyed	Usually short (to 5 Cm.)	Irregular annular constriction	Absent	Upper jejunum
LYMPHOSARCOMA (Primary malignant tumors)	Thickened, edematous and/or destroyed	Usually long (8-20 cm.)	Irregular constriction or widening	Absent	Ileum
METASTATIC TUMOR	Distorted or obliterated	Variable	Narrowed asymmetrical	Diminished or absent	Non-specific
FOREIGN BODIES	Unaltered or slightly flattened	Short	Oval or round filling defect	Unaltered	Non-specific

Fig. 7. Characteristics of the obstructing segment.

tension and invasion may produce a short defect similar to that caused by a primary malignant tumor and may be annular or asymmetrical. Peritoneal implants may cause single or multiple areas of stenosis, fixation, and deformity of variable length. The single implant may lead to a kinking in the adjacent loops, resulting in a contour which is similar to that produced by peritoneal adhesions. Longer and more irregular deformities are associated with multiple implants. The loops may be displaced by an intra-abdominal mass and either held firmly together or widely separated by tumor. Varying degrees of stenosis can be identified in adjacent loops, and fixation makes separation by palpation difficult or impossible. The mucosal pattern is usually preserved, but the folds may be widened and edematous. Peristalsis is diminished or absent through the involved segments.

Foreign bodies, such as gallstones (17), seeds, etc., may cause partial obstruction. Radiopaque foreign bodies may be identified on the scout film of the abdomen, while non-opaque objects produce filling defects of varying size and configuration in the barium column. The contour and position may change during observation and palpation. Peristaltic waves pass through the wall of the small intestine, and the mucosal pattern is preserved but may appear flattened and "ironed-out."

DISCUSSION

Changes observed in the segment of small intestine immediately proximal to the point of obstruction are not completely specific. Some of them may also represent localized manifestations of systemic diseases. Differentiation between these entities may be possible only after evaluation of the clinical history and physical and roentgen examination. In partial obstruction, however, the changes are localized, whereas in the systemic diseases they are more generalized and are usually inconstant in location and contour. One or several of the abnormalities may be present to aid in localizing the lesion.

The obstructing segment must be identified as a constant area of narrowing of the lumen which persists during peristalsis. The character of the change demonstrated by spot roentgenograms may be helpful in establishing the cause of the obstruction, but it is frequently non-specific and the true nature of the lesion is disclosed only at surgery or by microscopic studies. Certain generalizations, however, may be made. Single short stenotic segments usu-

ally represent a neoplastic process, either a primary or metastatic tumor. Multiple short stenotic segments may be seen in chronic inflammatory lesions which have become fibrotic. Long obstructive segments are usually indicative of inflammation. The reverse, however, may occur, and the roentgen changes may not be sufficiently characteristic to permit differentiation. Intussusception appears to produce the most bizarre deformities and presents a difficult problem for study because of the varying degrees of change that may occur. Lymphosarcoma causes several different types of deformity in the small intestine, so that no single lesion may be regarded as specific. However, it is probably the only lesion which may produce an increase in the diameter of the lumen at the site of disease. The occasional simultaneous appearance of identifiable lesions in the stomach and small intestine suggests that lymphosarcoma is the most likely diagnosis. At present, it appears important for the radiologist to establish the presence of a partial obstruction and to attempt continued study of the obstructing segment with the object of making a more definite etiological diagnosis.

SUMMARY

1. The roentgen diagnosis of partial obstruction of the small intestine has been discussed with special reference to changes which aid in localizing and studying the obstructing segment.

2. The anatomical changes in the segment proximal to the lesion may indicate that a partial obstruction is present. One or more of the following abnormalities may be identified: (*a*) gas within the lumen of the small intestine; (*b*) an increase in the caliber of the small intestine as identified by either a barium mixture or intraluminal gas; (*c*) abnormal mucosal pattern; (*d*) delay in the transit time of the barium column; (*e*) segmentation of the barium column; (*f*) abnormal position or mobility of the individual segments of the bowel; (*g*) abnormal peristaltic activity.

3. The obstructing lesion has been studied with reference to mucosal pattern, general contour and deformity, and behavior during peristalsis. A number of cases of partial obstruction of the small intestine studied by a routine oral method with serial films, fluoroscopy, and spot radiographs, are reported.

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SUMARIO

Oclusión Parcial del Intestino Delgado con Referencia Particular al Segmento Oclusivo

Esta reseña del diagnóstico roentgenológico de la oclusión parcial del intestino delgado versa en particular sobre las alteraciones que ayudan a localizar y estudiar el segmento oclusivo. Preséntanse varios casos estudiados con un método sistemático, comprendiendo administración oral de bario, radiografías seriadas, roentgenoscopia y radiografías instantáneas.

Las alteraciones anatómicas del segmento proximal a la lesión pueden indicar la presencia de una oclusión parcial. Cabe identificar una o más de las siguientes anomalías: (*a*) gas dentro de la luz del intestino delgado; (*b*) aumento del calibre del intestino delgado, revelado ya por una mezcla de bario o por gas intraluminal; (*c*) patrón anormal de la mucosa; (*d*) demora en el paso de la columna de bario; (*e*) segmentación de la columna de bario; (*f*) posición o movilidad anómalas de los distintos segmentos del intestino; (*g*) peristaltismo anormal.

El segmento oclusivo puede revelar alteraciones del patrón de la mucosa, del contorno general y del comportamiento durante el peristaltismo. En general, los hallazgos son éstos:

Lesiones inflamatorias (subagudas y crónicas)
- Mucosa edematizada; a veces destruída.
- Contorno asimétrico y estrechado.
- Peristaltismo atenuado o extinto.

Tumores benignos
- Patrón de la mucosa inalterado aparte de la base de la lesión; invaginación.
- Nicho intraluminal.
- Contorno netamente demarcado, redondo u oval.
- Peristaltismo inalterado; atenuado si hay invaginación.

Carcinoma primario
- Patrón de la mucosa destruído.
- Lesión por lo general corta (5 cm. o menos).
- Estenosis anular irregular.
- Peristaltismo extinto.

Linfosarcoma
- Mucosa espesada, edematosa o destruída.
- Lesión por lo general larga (8–20 cm.).
- Estenosis o ensanchamiento irregular del segmento afectado.
- Peristaltismo extinto.

Metástasis neoplásicas
- Patrón de la mucosa deformado u obliterado.
- Estrechamiento asimétrico del segmento.
- Peristaltismo atenuado o extinto.

Cuerpos extraños
- Patrón de la mucosa inalterado o levemente aplanado.
- Nicho oval o redondo.
- Peristaltismo inalterado.

Primary Pneumaturia, with a Report of Two Cases[1]

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THE TERM "pneumaturia" signifies the passage of gas from the bladder during micturition or on catheterization. Secondary pneumaturia is not uncommon and results from the introduction of atmospheric air into the bladder by instrumentation or the passage of gas from a hollow viscus through a fistulous opening into the bladder. Primary pneumaturia is rare and is due to fermentation of urine in the bladder through the agency of some fermenting organism. Cases of primary pneumaturia may be subdivided into two groups, depending upon whether or not the urine contains glucose.

TABLE I: RECORDED CASES OF PRIMARY PNEUMATURIA

With Glycosuria		
1883	Guiard (8)	4 cases
1883	Duménil and Guiard (9)	1 case
1883	Thomas (cited by Senator, 10)	1 case
1888	Teschenmacher (11)	3 cases
1889	Müller (12)	1 case
1891	Senator (10)	1 case
1898	Frisch (13)	1 case
1905	Van Loghem (14)	1 case
1921	Müllern-Aspergen (15)	1 case
1922	Young (16)	1 case
1937	Riley and Bragdon (4)	1 case
1948	Arthur and Johnson (3)	1 case
1950	Danzer (1)	1 case
	TOTAL	18 cases
Without Glycosuria		
	To 1898, Kelly and MacCallum (17) reviewed the literature and found	7 cases
1898	Kelly and MacCallum (17)	1 case
1901	Wildbolz (18)	1 case
1907	Adrian and Hamm (19)	4 cases
1907	Taussig (6)	1 case
1914	Cealic and Ceocalteu (20)	1 case
1923	Thevenot and Lebœuf (21)	1 case
1930	Ota and Masuda (cited by Riley and Bragdon, 4)	1 case
1934	Mulsow and Gillies (2)	1 case
	TOTAL	18 cases

The extremely small number of cases of primary pneumaturia on record, the almost total absence of discussion of this subject in the roentgenologic literature, and the fact that the roentgen examination offers probably the easiest method of diagnosis are justification for the present report. Only four references (1–4) could be found to the roentgen diagnosis of primary pneumaturia. The two cases to be reported here constitute, therefore, the fifth and sixth in which the diagnosis was established or confirmed roentgenologically. They are the ninth and tenth examples of primary pneumaturia to appear in the American literature (Table II).

TABLE II: CASES OF PRIMARY PNEUMATURIA IN THE AMERICAN LITERATURE

1882	Keyes (7)	1 case
1898	Kelly and MacCallum (17)	1 case
1907	Taussig (6)	1 case
1922	Young (16)	1 case
1934	Mulsow and Gillies (2)	1 case
1937	Riley and Bragdon (4)	1 case
1948	Arthur and Johnson (3)	1 case
1950	Danzer (1)	1 case
	TOTAL	8 cases

The earliest mention of a case of pneumaturia appeared in 1671 in a publication called "Curiosities of Nature." Raciborski's (5) Latin quotation from the original article was translated by Taussig (6) as follows: "A leading citizen of Gotha was afflicted by anal colic, with rumbling tension in the abdomen, pain about the navel and, what is strange, wind was passed by the penis, as if through the usual and accustomed channel, sometimes with and sometimes without urine." The first detailed case reports of the condition were those of Raciborski in 1860 (5) and Keyes in 1882 (7).

Guiard (8) and Duménil and Guiard (9), in 1883, were the first to point out the relationship between pneumaturia and diabetes mellitus, suggesting that the pneumaturia resulted from fermentation of glucose within the bladder. Mulsow and Gillies (2), however, were impressed by the rarity of pneumaturia in diabetics, in spite of the fact that the colon bacillus, which readily ferments glucose, is so fre-

[1] Accepted for publication in October 1951.

quently found in the urine of diabetic patients.

Arthur and Johnson (3) believe that the following conditions must in general be present to cause primary pneumaturia: bacteriuria (*E. coli* being the only organism common to all cases), glycosuria, albuminuria, pyuria, and residual urine. It is pointed out by these writers that the method of gas production by *E. coli* is unknown. The urine, they believe, may contain a substance capable of being split by fermentation with the production of an insoluble gas. Pneumaturia does not result from the ordinary ammoniacal fermentation of urine or from putrefactive decomposition because the hydrogen sulfide gas which is formed is soluble in urine. The theory is offered that possibly certain of the colon bacilli have greater gas-producing power than others and that some of the gases produced are insoluble in urine.

To date (1951) only 36 cases of primary pneumaturia have been reported, 18 with glycosuria and 18 without.

As previously mentioned, reference to the roentgen diagnosis of primary pneumaturia occurs, to date, in only four publications (1–4). The first of these is that of Mulsow and Gillies (2). In their case roentgenologic examination revealed a large, smooth, spherical mass in the pelvis, 6 inches across, half filled with fluid, with gas above. The barium-filled stomach was pushed upward and the colon was displaced by the pelvic mass.

The second case in which a roentgen diagnosis of pneumaturia was made is reported by Riley and Bragdon (4). An abdominal roentgenogram revealed air bubbles in the urinary bladder area, and catheterization corroborated the presence of air in the bladder. These authors caution that the gas in the bladder may not be recognized but may be mistaken for gas in the bowel.

The third reference to the roentgen diagnosis of pneumaturia is to be found in the report of Arthur and Johnson (3) who demonstrated the presence of gas in the urinary bladder by intravenous pyelography.

Fig. 1. Case I: Roentgenogram of pelvic region showing tremendous ovoid pelvic gas pocket.

In the fourth case diagnosed roentgenologically, that of Danzer (1), anteroposterior and lateral films of the abdomen revealed a pear-shaped mass of decreased density reaching above the umbilicus, interpreted as an air-filled bladder. The patient was catheterized while on the x-ray table, and a large amount of gas was expelled through the catheter. A roentgenogram obtained after catheterization showed that almost all of the gas had disappeared. Danzer concludes that it is likely that pneumaturia occurs much more commonly than is generally realized and that small amounts of air in the bladder are probably frequently mistaken for air in the sigmoid.

CASE REPORTS

CASE I: A woman of 56 years was first seen in consultation by one of the writers (D. N. R.) on Oct. 9, 1948, for confirmation of a diagnosis of ovarian cyst. X-ray examination had revealed what was erroneously interpreted as an obstructed and enormously dilated pelvic colon. Immediate operative removal of the cyst, which was thought to cause the obstruction, had been advised. The patient was a diabetic with a history of severe constipation, pain in the right lower abdomen, 30 pounds loss in weight, dribbling of urine for the past two years, and increasing prominence of the lower abdomen.

Palpation and percussion of the abdomen revealed

a large tympanitic mass which extended from the pubis to the umbilicus. The urine contained many white cell clumps, albumin, and sugar. Roentgen examination by one of the writers (S. F.), on Oct. 11, demonstrated a tremendous pelvic gas pocket (Fig. 1), which was interpreted as a dilated gas-filled urinary bladder, partially compressing the sigmoid colon (Fig. 2).

Urologic examination on Oct. 20 (W. L. F.) disclosed a large suprapubic, tympanitic mass, soft and cyst-like. After the patient voided, a catheter was passed into the bladder. Approximately 400 c.c. of foul smelling turbid urine was expelled under great pressure, followed by an explosive passage of a great deal of gas through the catheter. The abdominal mass immediately disappeared. The urine on culture showed *B. aerobacter aerogenes*. Retrograde cystography, Oct. 20, with 600 c.c. of 3 per cent sodium iodide revealed a large bladder (Fig. 3). On cystoscopic examination, two days later, a violent expulsion of gas and urine again occurred, on removal of the obturator from the cystoscopic sheath. Inspection of the bladder disclosed a diffuse ulcerative and hemorrhagic cystitis, with a purulent fibrinous exudate, adherent to the bladder wall. The ureteral meati appeared to be normal. The bladder showed moderate trabeculation and the sphincter margin was normal. These findings confirmed the diagnosis of an infected neurogenic bladder, with primary pneumaturia, in a diabetic patient.

Fig. 2. Case I: Roentgenograms showing huge pelvic gas pocket, interpreted as a dilated gas-filled urinary bladder, partially compressing the sigmoid colon.

Fig. 3. Case I: Retrograde cystogram showing the urinary bladder filled with 600 c.c. of 3 per cent sodium iodide.

The patient was hospitalized on Oct. 24, 1948. On the following day, excretory urography revealed a normal upper urinary tract. The excretory cystogram, obtained after voiding, showed, however, a considerable residue of opaque dye-urine mixture, capped by a large amount of gas (Fig. 4).

On the tenth day of hospitalization, approximately 2 gm. of tissue were resected transurethrally from

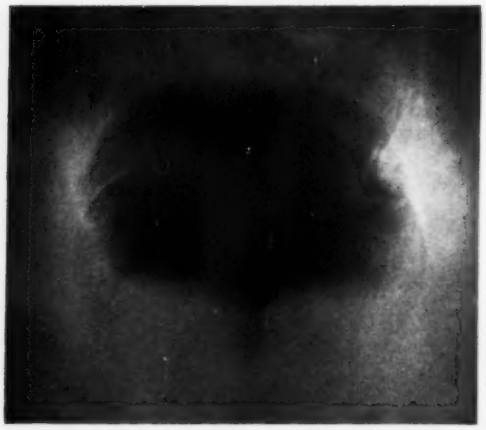

Fig. 4. Case I: Excretory urogram obtained after voiding, showing a considerable residual opaque dye-urine mixture, capped by a large amount of gas.

the posterior bladder sphincter margin, in an effort to reduce the amount of residual urine. Aureomycin was administered at the same time. However, no appreciable reduction in the amount of residual urine or in the degree of bladder infection was obtained.

The patient left the hospital, but a week later was admitted to the Sydenham Hospital in coma. A huge tympanitic mass was again palpable. On catheterization 3,000 c.c. of purulent urine was removed, followed by forceful expulsion of gas. The urine contained a high concentration of sugar and acetone. The blood sugar at this time was 880 mg. per cent; the urea nitrogen 84 mg. per cent. Attempts to control the diabetes were unsuccessful and death ensued in forty-eight hours. Permission for autopsy could not be obtained.

CASE II: A woman 51 years of age, with a diagnosis of hypertensive heart disease, was admitted to Sydenham Hospital on Feb. 27, 1949, in cardiac failure. There was also a history of marked urinary frequency and dysuria. Abdominal examination was difficult because of great distention. The blood urea nitrogen was 43.4 mg. per cent and the specific gravity of the urine varied from 1.002 to 1.007. The blood sugar was 146 mg. per cent. A glucose tolerance test confirmed the diagnosis of diabetes.

Roentgenographic examination (W. L. F.) showed a radiolucent area, suggestive of gas in the bladder (Fig. 5). Excretory pyelography was attempted but, due to azotemia, visualization of the upper urinary tract was not satisfactory. Roentgenograms obtained at intervals up to one hour revealed progressive increase in the size of the pelvic radiolucent area (Fig. 6). On cystoscopic examination, 1,500 c.c. of residual urine was removed, followed by an explosive expulsion of gas. On inspection, the bladder mucosa was seen to be edematous and hemorrhagic. There was no vesical neck obstruction. A retrograde cystogram showed a pear-shaped trabeculated bladder (Fig. 7). Neurologic examination dislosed a diminution of all deep reflexes and decreased vibratory sense in both lower extremities. These findings established the diagnosis of an infected neurogenic bladder with primary pneumaturia in a diabetic patient.

By transurethral resection, 3 gm. of tissue were removed from the posterior lip of the vesical sphincter margin. Examination of this tissue showed chronic inflammatory reaction. The patient was put on penicillin and aureomycin therapy. Her general condition showed progressive improvement. The blood urea nitrogen dropped to 36 mg. per cent and the blood sugar decreased to 128 mg. per cent. By May 16, the urinary frequency had been considerably reduced. Whereas on admission to the hospital the patient was voiding every fifteen to thirty minutes, she was now able to retain the urine for three hours. The residual urine was reduced from 1,500 c.c. to 50 c.c. Urine culture, however, continued to show the presence of *B. coli*.

The patient was discharged on June 11, 1949, and was observed at frequent intervals in the out-patient department for five months. During this period she continued to be free of all urinary complaints, though the urinary infection persisted. She failed to return for further observation.

Fig. 5. Case II: Pelvic roentgenogram showing a radiolucent area in the bladder region, suggestive of gas in the bladder.

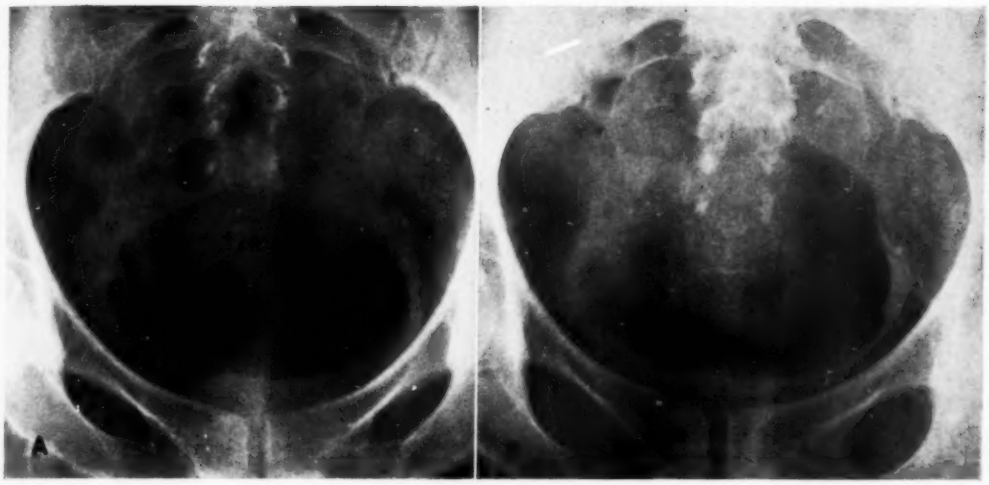

Fig. 6. Case II: Pelvic roentgenograms following excretory pyelography, showing progressive increase in the amount of gas in the bladder.

DISCUSSION

Primary pneumaturia should be distinguished from the pneumaturia which accompanies a vesico-intestinal fistula or follows the instrumental introduction of air into the bladder. The reported cases appear to be equally divided between diabetic and non-diabetic patients. Vesical retention is invariably present. In the diabetic cases, diabetic neuropathy with a consequent "neurogenic bladder" is the basis for the residual urine. In others, vesical neck obstruction has been found responsible for the retention. There is an associated urinary infection. Azotemia ultimately develops unless the condition is diagnosed and adequate treatment is instituted. A significant clinical finding is the presence of a suprapubic tympanitic mass, which may reach well above the umbilicus. The gas is passed at the end of voiding, but the patient is not always aware of the passage of gas from the bladder. Its presence is frequently first detected by catheterization or by roentgen study.

During cystoscopic examination, the examiner will be impressed by the sudden explosive passage of gas after the bladder has been emptied of the retained urine.

Fig. 7. Case II: Retrograde cystogram showing a pear-shaped trabeculated bladder.

The bladder mucosa presents varying degrees of inflammation. We do not believe that cystitis emphysematosa, which

may occur in some cases of chronic cystitis, is related to primary pneumaturia.

Roentgen examination may offer the first clue to the presence of an accumulation of gas in the urinary bladder. A rounded or pyriform gas shadow in the suprapubic region which does not resemble gas in a distended rectosigmoid should always suggest pneumaturia. When an excretory cystogram can be obtained, a picture presents itself in which the opaque medium-urine mixture is capped by a large amount of gas in the distended bladder. In the upright position a fluid level can be demonstrated.

The exact mechanism of the production of gas is not known. It is believed, however, that in diabetics the glucose present in the urine is fermented by bacteria which have exceptional gas-producing properties. The gas thus formed must be insoluble in the urine. Otherwise its presence could not be detected. In non-diabetics, it is believed that the gas is produced through the action of certain bacteria on an albuminous protein present in the urine. The bacteria found in most of the cases reported in the literature were *E. coli*. *B. aerogenes capsulatus* and *B. lactis aerogenes* have also been identified in some of these cases. The gas produced has been collected and analyzed and found to consist of hydrogen, nitrogen, and carbon dioxide.

The treatment of primary pneumaturia has included the use of antibiotics, diabetic control, and elimination of residual urine whenever possible. Transurethral resection of a small amount of tissue from the posterior margin of the vesical neck in cases of diabetic vesical neuropathy is recommended. The pneumaturia in most cases can be eliminated with judicious treatment. Most of the patients, however, succumb as a result of renal insufficiency due to pyelonephritis.

NOTE: The authors are indebted to Dr. Emanuel Appelbaum, Director of the Medical Service, Sydenham Hospital, for permission to report Case II.

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SUMARIO

Neumaturia Primaria, con Presentacion de Dos Casos

Los 2 casos de neumaturia primaria aquí descritos parecen ser el 37° y el 38° comunicados hasta ahora, el 9° y el 10° que aparecen en la literatura estadounidense, y el 5° y el 6° diagnosticados roentgenológicamente. Ambos casos estaban asociados con diabetes, como sucedió también en la mitad de los casos comunicados anteriormente.

La neumaturia primaria se debe a la fermentación de la orina en la vejiga con la formación de un gas insoluble. Parece que, en la diabetes, la glucosa presente en la orina es fermentada por bacterias dotadas de inusitadas propiedades aerógenas. En los sujetos no diabéticos, parece que el gas es producido por la acción de ciertas bacterias sobre una proteína albuminosa contenida en la orina. En la mayor parte de los casos, se ha encontrado la *E. coli*.

El examen roentgenológico revela una imagen redondeada o piriforme de gas en la región suprapúbica. Un cistograma excretorio, si puede obtenerse, muestra una mezcla del medio opaco y de la orina en la distendida vejiga, rematada por una gran cantidad de gas. En la posición erecta puede observarse un nivel de líquido.

Glomus Jugularis Tumor of the Middle Ear[1]

A Case Report

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PRIMARY TUMORS of the middle ear are extremely rare. Schall reported the incidence as 1 in 6,000 cases of disease of the ear. Marx collected 155 cases, of which the majority were squamous-cell carcinomas. His series included, also, 15 cases which he described as endothelioma, and among this number may well be some examples of what has more recently come to be known as "glomus jugularis tumor."

Most of the symptoms of these tumors are non-specific. Deafness, headache, facial paralysis, dizziness, discharge from the ear, and soft, dark, purplish masses in the external canal are the signs and symptoms. Progressive expansive growth leads to destruction of the temporal bone, as a result of pressure atrophy, and extension into the cranial cavity with compression of cranial nerves. Hemorrhage makes operative removal rather difficult. The microscopic picture is generally comparable to that of tumors of the carotid body. The tumor is vascular, with "epithelioid cells" lining the blood spaces.

The terms "glomus jugularis tumor" and "carotid body-like tumor" have come into use in the last five or six years, following a report by Rosenwasser in 1945 describing what he called a carotid body tumor in the middle ear, extending into the mastoid process, in the absence of a demonstrable tumor of the carotid body in the neck. The origin was believed to have been in the paraganglion structure in the adventitia of the bulb of the jugular vein or along the ninth cranial nerve. In a tentative explanation of the occurrence of a carotid body tumor at this site, Rosenwasser went back to a communication by Guild in 1942, describing the glomus jugularis in the temporal bone. "Human temporal bone sections," wrote Guild, "reveal structures in several respects like the carotid body, for which the name glomus jugularis is proposed. Usually they are found in the adventitia of the dome of the jugular bulb, immediately below the bony floor of the middle ear and near the ramus tympanicus of the glossopharyngeal nerve. . . Presumably it has functions like the carotid body, perhaps limited to a smaller circulatory region." It was suggested that like structures might be found along other portions of the circulatory system.

Glomus tumors, which are tumors of highly specialized glomic arteriovenous anastomoses, can develop not only at the junction of skin and subcutaneous tissues but may also occur in deeper structures. Murray states that glomus tumors may be infiltrative, indicating that not all are thoroughly encapsulated. The epithelioid cell is the same as the so-called "pericyte" of Zimmermann, which is a type of cell transitional between an endothelial capillary cell and a smooth muscle cell. This identification offers a satisfactory explanation for the occurrence of glomus tumors in sites where normal glomera have not been found.

Rosenwasser in reporting his case listed the x-ray findings as revealing good pneumatization on both the right and left side in the mastoid region. On the side of the tumor there was marked clouding of the periantral region and decalcification of the septum in the perisinuous region without distinct abnormality of the petrous bone. At surgery a purplish tumor arising from the middle ear, attached to the hypotympanum and apparently involving the jugular dome, was removed.

[1] From Hermann Hospital, Houston, Texas. Accepted for publication in October 1951.

The pathological report was "carotid body tumor."

In 1947 LeCompte reported a case which was very similar to that of Rosenwasser. Roentgenograms of the mastoid region showed sclerosis and thickening of the septa of air cells consistent with sclerosing mastoiditis on the involved side. LeCompte agreed that the tumor he reported had characteristics of the carotid body and that such a tumor might arise in the histologically similar glomus jugularis of Guild. He did not believe this type of tumor was or could be malignant.

A third case was published by Kipkie in the same year.

Meantime, Capps in 1944 had reported 2 cases of "hemangioendothelioma" of the middle ear, which were said by LeCompte to resemble his case histologically, and which Capps himself subsequently recognized as glomus jugularis tumors.

At the time of Capps's report he had searched the literature for similar cases but had found only a few, recorded under various names. No mention of large destructive areas in the region of the mastoid were noted in his review, nor did he make any mention of x-ray findings. He stated that it would seem probable that the vaso-formative elements of these tumors arise from capillaries of the mucosa of the middle ear, either that covering the inner wall or the mucosal lining of the tympanic membrane.

In 1948, Winship, Klopp, and Jenkins reported what they described as a metastasizing tumor of the glomus jugularis. Roentgenograms showed a marked difference in the appearance of the mastoids on the two sides. The cells of the left mastoid were quite cloudy and the septa were obscured. The left canal was cloudy as compared to the right, and its bony walls were of decreased density. The findings were interpreted as indicative of a new growth involving the bony walls of the auditory canal, and the clinical impression was cholesteatoma. Small doses of x-rays were given, and eleven years later the patient had a paresis of the 7th, 8th, 10th, 11th, and 12th nerves. Roentgenograms were reported to have revealed extensive destruction of the left mastoid and inner petrous pyramid.

The structural unit of the carotid body tumor is a group of variable-sized "chief cells" surrounded by vascular stroma. There is clear eosinophilic cytoplasm with eosinophilic granules and vesicular nuclei. Usually there is no mitotic activity. These tumors are considered to be different histologically and histochemically from the chromaffin paraganglia in the adrenal and along sympathetic chains. They have been classified as non-chromaffin, non-epinephrine paraganglioma. Eleven cases were discovered and reviewed at Memorial Hospital in 1948. LeCompte did not favor the term "paraganglioma," considering the term "carotid body tumor" to be more sound.

CASE REPORT

A 42-year-old colored woman reported to the Out-Patient Clinic on March 5, 1951. In November 1947 she had consulted a physician because of pain in the left ear, which had persisted for four years, and gradually increasing difficulty in speaking. At examination on this earlier occasion a rather hard, sclerotic protrusion was found, emanating from the external canal of the ear, bleeding easily on manipulation. The patient also gave a history of a stroke six years earlier. This was followed by hoarseness, which she was told was due to paralysis of the left vocal cord.

Pain in the ear persisted, with drainage, and in 1949 an operation was done for cholesteatoma. Since that time there had been no sense of hearing in the left ear.

When seen in March 1951, the patient complained of headache in the frontal region, radiating along the left side of the head. Vomiting occurred in association with the headaches. There was no history of convulsions, but the patient stated that some three weeks earlier she had awakened one morning and discovered that she had had a "stroke," with paralysis of the left side of the face. This had persisted up to the time of her visit to the Clinic. She denied paralysis of the left arm or leg.

Physical examination revealed a Bell's palsy on the left, left-sided deafness, and a discharge from the left ear. The patient also complained of tinnitus. The heart and chest were normal. The blood pressure was 160/110. Neurologic examination disclosed, in addition to the left peripheral seventh nerve palsy and deafness, a blurring of the

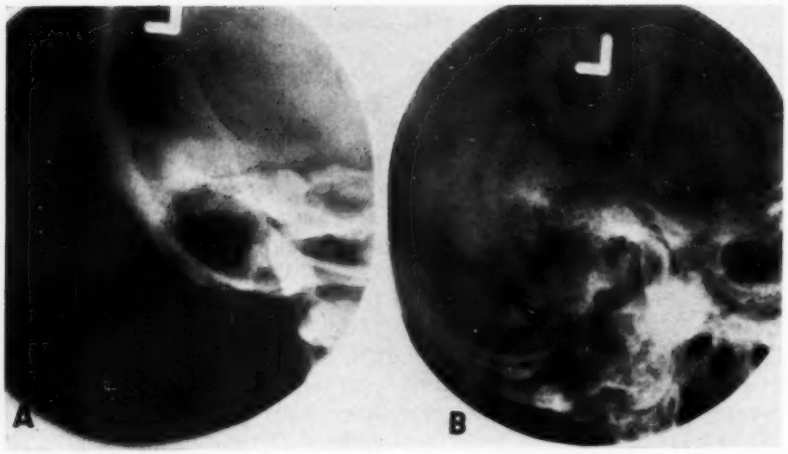

Fig. 1. A. Stenvers' projection of left mastoid, showing the bone destruction in the left mastoid process. This resembles a surgical defect, but is much more extensive than would be due to usual mastoid surgery.

B. Law's position. Disorganization of cells with loss of bony septa and destruction of petrous portion of temporal bone.

The lateral sinus plate is ill defined, indicating extension to the region of the lateral sinus. This was confirmed at surgery, with excessive bleeding from the sinus on attempted removal of the tumor.

Fig. 2. Towne's position, showing bone destruction in left petrous ridge and mastoid process and irregularity of the internal auditory canal. The tegmen is intact. The main area of destruction is in the region of the tympanic cavity, anterior and inferior to the antrum. A widespread cholesteatoma could simulate this picture and must be considered in the differential diagnosis.

optic disk with no papilledema and a questionable vocal cord paralysis. The reflexes were normal, as were vibratory and position sense.

Roentgen examination revealed an extensive destructive process involving the left mastoid and petrous portion of the temporal bone and the base of the skull (Figs. 1–4).

The patient was followed for a time in the Out-Patient Department and was then admitted to the hospital for further study. Other findings on admission were deviation of the tongue to the left, deviation of the soft palate to the right, and lateral nystagmus, more pronounced on the left. Pneumoencephalography and ventriculography were done, and the patient was subsequently subjected to a posterior fossa craniotomy. A tumor was encountered involving the mastoid bone. Since this was believed to be a metastasis, and because of hemorrhage from the region of the lateral sinus, removal was not complete. Postoperative irradiation was given between May 16 and June 27—2,600 r (in air) to each of three portals over the left mastoid region, for an estimated tumor dose of 4,600 r. The response was favorable, with some relief of headache and improvement in function of the involved cranial nerves. When the patient was seen in July, however, granulation tissue was still present in the external canal and drainage persisted.

The pathological report (Violet Keiller, M.D.) was as follows:

"The tumor is composed of small, irregular, endothelial-lined spaces, surrounded by packets and strands of ovoid discrete cells [Fig. 5]. Individual

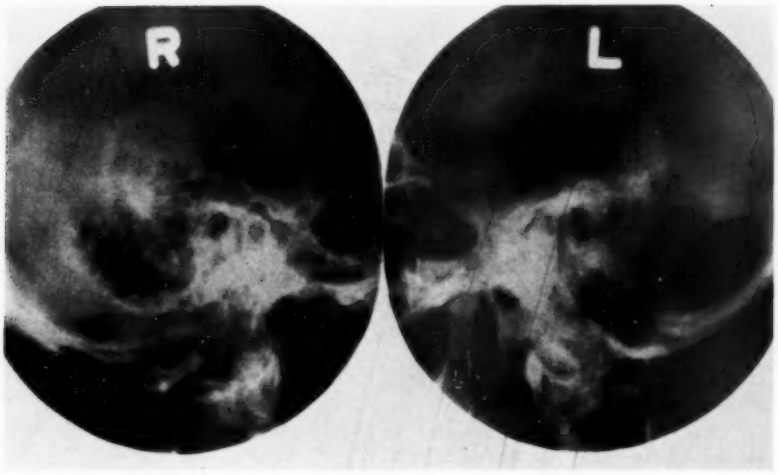

Fig. 3. Normal right mastoid and pathological left mastoid with large rarefying area representing extensive bone involvement.

tumor cells are small, with uniform, relatively large nuclei. The bone specimens are infiltrated widely by tumor between fairly well preserved bone lamellae [Fig. 6]. No osteoblastic proliferation is seen.

"The growth pattern suggests a locally invasive type of low-grade perivascular sarcoma of glomus or carotid body type.

"Study of reported cases of glomus jugulare tumors of the posterior fossa provided the correct terminology. In one of the reports there is a statement of especial interest in this case; namely, that this tumor is 'often seen first protruding from tympanic membrane.'

"Pathologic Diagnosis: Glomus jugulare tumor."

DISCUSSION

X-ray examination in this case showed widespread destruction of cells in the mastoid process with extension into the mastoid antrum. This is clearly shown in the Stenvers' position (Fig. 1). The semicircular canals are apparently intact, as is the arcuate eminence.

Films obtained in Towne's position (Fig. 2) show destruction of cells in the mastoid antrum beneath the posterior aspect of the tegmen. Disorganization of cells in the petrous apex, together with a destructive process in the tympanic cavity anterior and inferior to the antrum, is also demonstrated. There is poor definition of the superior and inferior walls of the external auditory canal.

Fig. 4. Reverse Stenvers' position, again showing erosion of the left mastoid process; sclerosis in area of semicircular canal; haziness of cells in petrous apex. On the original film some extension through the tegmen into the cranial cavity could be detected.

Figure 3 affords a comparison between the normal appearing right mastoid process and the involved left mastoid. The adequate, adult, pneumatized cells on the right side indicate that the patient

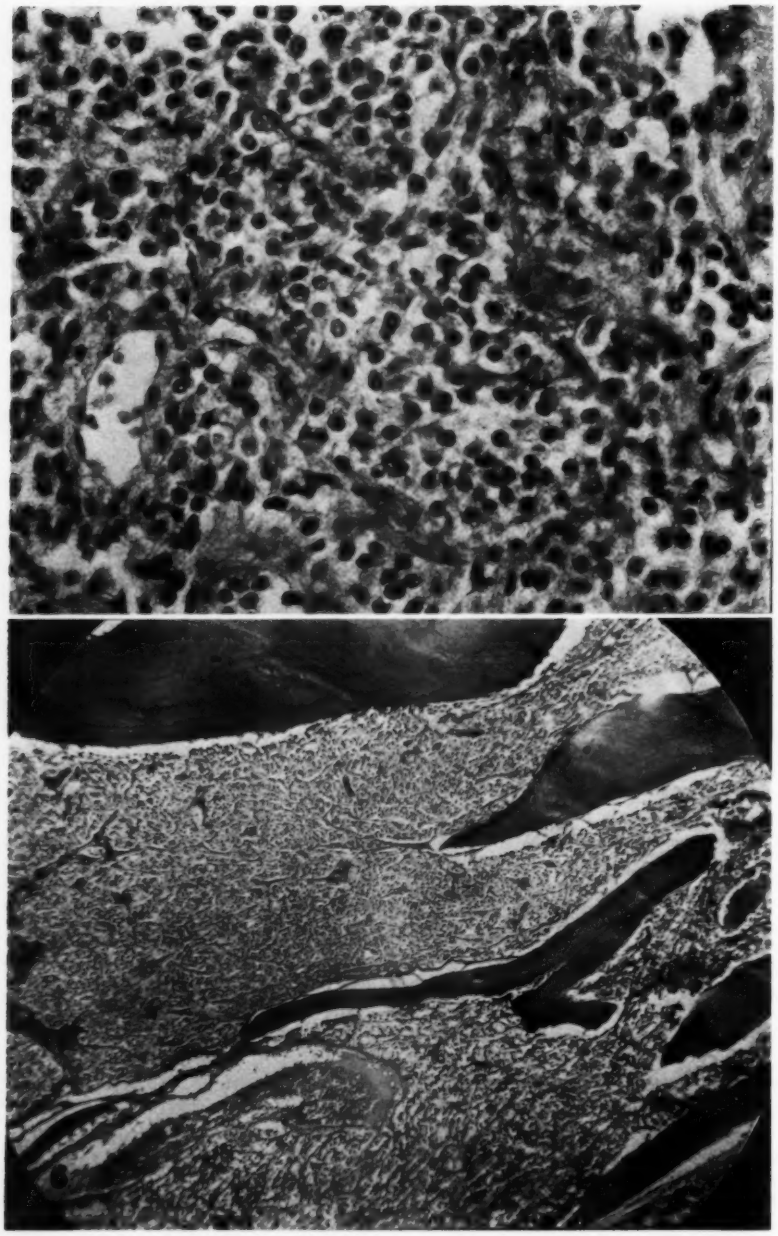

Fig. 5. Representative section of the tumor, showing the endothelial-lined spaces with small eosinophilic staining cells having large nuclei. The cells are in small groups in a delicate stroma.

Fig. 6. Photomicrograph showing the invasive nature of the neoplasm, with infiltration of bone. This confirms the roentgen findings described elsewhere.

did not have previous mastoid infection or disease, and the very irregular destructive process on the left suggests the presence of a new growth rather than changes due to an inflammatory process.

The main consideration in differential diagnosis would seem to be a cholesteatoma. Cholesteatoma is a common complication of otitis media, said to be due to a low-grade chronic infection. The normal mucosa of the middle ear is gradually destroyed and replaced by epidermal cells. The dead epidermal cells accumulate in a mass in the attic and antrum, with eventual erosion of the bony walls of the cavities as a result of pressure. Usually, because of the slow growth of these pseudo-tumors, a protective zone of calcification forms around the periphery of the mass so that they are manifested as sharply marginated areas of rarefaction. Because they occur in sclerotic mastoids, they must be distinguished from abscess cavities, which are more apt to occur laterally.

Other conditions to be considered in the differential diagnosis are surgical defects, benign tumors, fibrous dysplasia, and other malignant tumors. In our case, the destructive process was much more extensive than one would expect to see in a surgical defect even for a radical mastoidectomy. Benign tumors are infrequently demonstrated unless they attain sufficient size to produce an abnormal density. This applies to osteomas, dermoids, and angiomas. Fibrous dysplasia may affect bones of the middle fossa and hence the mastoid, but it is usually manifested as a bony overgrowth with variations in density, and there is generally a rather definite limiting margin to the lesion. Malignant tumors, of course, can duplicate the picture of a glomus jugularis tumor. Primary carcinoma of the middle ear is rare; endotheliomas, as we have mentioned, have been described in this area. Pendergrass described one cancer of the mastoid with the bony destruction simulating the destruction in our case. The inner and middle ear can be secondarily involved by tumors arising from the floor of the middle fossa and nasopharynx, including carcinomas, lympho-epitheliomas, sarcomas, and meningiomas. Still more infrequently the mastoids may be involved by metastatic tumor arising from a distant primary source.

Neoplasms in the middle ear are usually accompanied by infection and they should be suspected in the presence of a chronic discharge. The possibility of making a differential diagnosis lies in the fact that if the process is well pneumatized it is very unlikely that it is a chronic otitis media per se. In our case the mastoids were of the adult type and the cellular absorption and decalcification were more destructive in nature than one might expect from long-standing infection. The presence of a growth in the external canal should certainly suggest a neoplasm.

SUMMARY

A case of glomus jugularis tumor of the middle ear is reported. The roentgen findings of extensive bone destruction in the mastoid process and petrous portion of the temporal bone as the result of pressure necrosis and extension are demonstrated, and the differential diagnosis is discussed. A brief review of the discovery and previous reports of this unusual tumor is given.

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SUMARIO

Tumor del Glomo Yugular en el Oído Medio. Historia Clínica

El caso presentado de tumor del oído medio corresponde al tumor del cuerpo carótido o del glomo yugular que Rossenwasser describiera por primera vez. El tumor fué descubierto radiográficamente en forma de extenso proceso destructor que afectaba las porciones mastoidea y petrosa izquierdas del hueso temporal y la base del cráneo. Uno de los primeros signos consistió en una tumefacción esclerosada dura que proyectaba por el conducto auditivo externo.

Estos tumores tienen que ser diferenciados del colesteatoma, de las deformaciones quirúrgicas consecutivas a una mastoidectomia anterior, de otros tumores y de la displasia fibrosa. Hay que sospechar su existencia en presencia de supuración persistente por el oído y de una tumefacción en el conducto externo.

Roentgenography of Fibroadenoma of the Breast[1]

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Fibroadenoma is a common and generally harmless tumor, the removal of which affords satisfaction alike to surgeon and patient. Much has been written about it because it is relatively easy to study and is a good starting point for the understanding of more complicated breast disorders. Its detection presents some fascinating radiologic problems. The pathologist may dismiss this easily recognized tumor with a curt diagnosis, but in his more reflective moments, he will find much to repay a closer acquaintance with its origin and structure.

PATHOLOGY OF FIBROADENOMA

This simple tumor has been burdened with an enormous number of names. Most of them are descriptive rather than fundamental. We believe that confusion will be saved by sticking in general to the name fibroadenoma, reserving "fibroma" for those tumors containing no epithelium and "adenoma" for those consisting only of glands and a very small amount of supporting stroma.

Fibroadenoma is the result of local irregularity in the cyclic changes of the breast. The way in which these tumors grow is readily understood from a consideration of normal growth and development of mammary tissue. As was shown by Peyron and his co-workers (7, 8) and more recently by Kuzma (5) and by Biggs (1), the lining epithelium of the ducts and the intraductal fibrous tissue immediately beneath it are both derived from the embryonic basal cells. These form epithelium and myoepithelium, the latter becoming converted into fibrous tissue. This process of fibrous tissue formation from myoepithelium can be followed rather easily in hyperplastic conditions. It is often seen in rapidly growing fibroadenomas, but is difficult to detect in normal tissue, especially with the usual hematoxylin and eosin stains. It can be shown to exist, however, when the tissue is properly fixed and suitable histologic stains are used.

Mazoplasia Group I of our classification is characterized by over-differentiation of the basal cells to the myoepithelial and connective-tissue side. This results in considerable increase of the intraductal fibrous tissue. In *Mazoplasia Group II*, differentiation of the basal cells into epithelium keeps pace more or less with myoepithelial growth, and the ducts, instead of being compressed as in *Mazoplasia I*, dilate and cysts are formed. If serial sections of mazoplastic breasts are studied under the dissecting microscope, numbers of small nodules are seen which show the same structure as a fibroadenoma. The great majority of these present hyperplasia of the subepithelial (intraductal) fibrous tissue (intracanalicular type). A few show groups of slightly dilated ducts and a more normal proportion of intraductal tissue (pericanalicular type). Many tumors are mixed, the tendency being for newly incorporated lobules to present a pericanalicular appearance, whereas older lobules show increased intraductal proliferation.

Fibroadenomas are influenced by the hormones of the sexual cycle in the same way as the rest of the breast, but the tumor tissue responds imperfectly. We have no clear idea why some areas should respond to hormonal stimuli with greater intensity than others. In the case of fibroadenoma, it would seem that some upset in the balance of hormones produces a general or focal mazoplasia. In the course of this

[1] From the Department of Radiology and Research Pathology, Albert Einstein Medical Center, Northern Division, Philadelphia, Penna. Accepted for publication in October 1951.

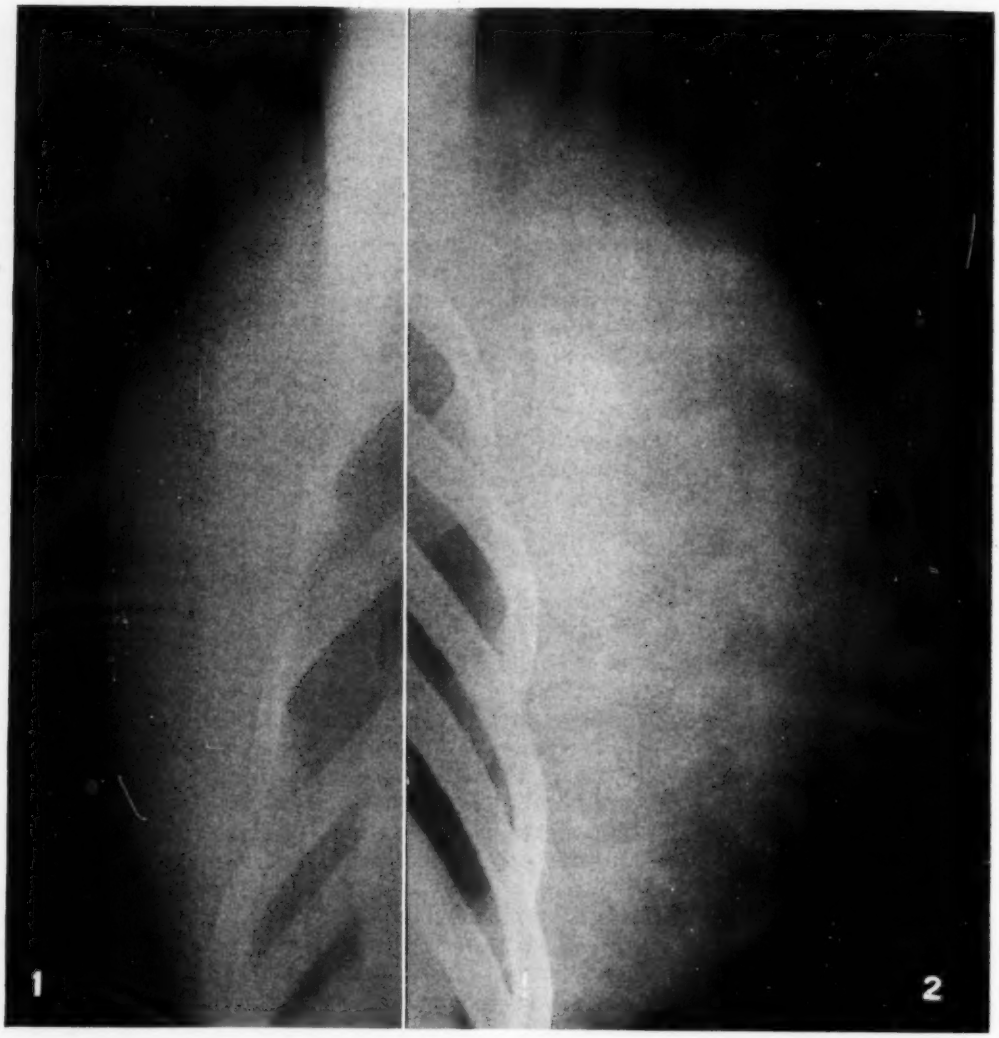

Fig. 1. Fibroadenoma not visible in compact adolescent mazoplastic breast. Patient aged 18. Lump in the breast, slightly painful, for five weeks. A small movable tumor was palpable. *Roentgenography:* No tumor visible in dense, compact mazoplastic tissue. *Pathology:* Broad bands of intraductal fibrous tissue separated by much perilobular connective tissue. (Dr. I. Greenspan.)

Note: The lead shot visible in this and in subsequent reproductions marks the site on the skin over the palpable tumor.

Fig. 2. Fibroadenoma not visible in adolescent mazoplastic breast. Patient aged 17. Palpable mass 2 cm. in diameter in the left breast for two months. *Roentgenography:* Mazoplastic fatty adolescent breast; no tumor visible. *Pathology:* Well encapsulated lobulated fibroadenoma, consisting of branching ducts of adolescent type.

process, the microscopic nodules described above are formed. Most of these return to normal when the hormone balance is restored. A few do not. With each menstrual cycle a certain amount of growth takes place in the tumor. This may be followed by partial, incomplete regression (4, 9), but on the whole the tumors tend to enlarge. Another source of tumor enlargement is the incorporation of adjacent mazoplastic lobules into the mass. This is almost always seen in younger

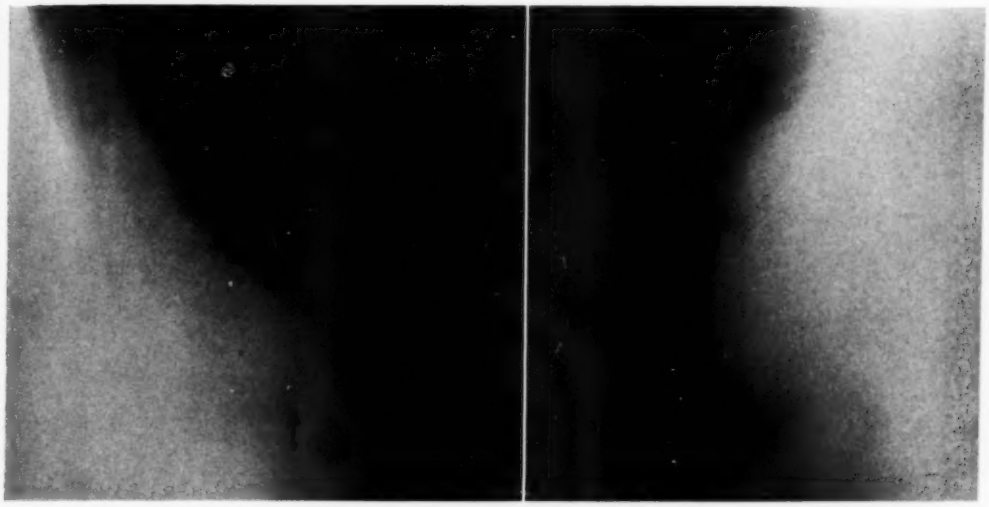

Fig. 3. Bilateral fibroadenoma. Patient aged 29. Masses palpable in both breasts for three years. *Roentgenography:* Sharply defined mass in each breast. Density of tumor like that of surrounding mazoplastic tissue except in layer of subcutaneous fat. *Pathology:* Both tumors fibroadenomas.

tumors and accounts for the agglomeration of nodules of which they are composed. After the menopause, most fibroadenomas become hyalinized, sometimes calcified, and the epithelium lining the ducts degenerates. Rarely, about the time of the menopause, there is an outburst of myoepithelial and epithelial hyperplasia in the tumor and a giant fibroadenoma is formed. Such tumors are seldom malignant in spite of the ferocious sarcomatous appearance of many under the microscope. It is possible to show that a small fibroadenoma consists of a terminal duct and its dependent lobules or branches. In very early stages, the duct is seen entering the tumor. Later, when the growth becomes encapsulated, the duct is compressed between the tumor and its capsule and no longer communicates with the rest of the breast (Fig. 9A). It may be that this loss of continuity acts to prevent the return to normal of the fibroadenomatous mass. The comparative rarity of multiple clinical fibroadenomas compared to the numbers of microscopic fibroadenomas in mazoplastic breasts affords reason to believe that early fibroadenoma is reversible.

ROENTGENOGRAPHY OF FIBROADENOMA

The roentgen examination of mammary fibroadenoma includes a lateral and tangential view of each breast (2). A small lead shot is placed on the skin over the tumor area for localization. The x-ray diagnosis is based on direct and indirect evidence, obtained only with meticulous technical care. The majority of fibroadenomas occur in late adolescence and early adult life, and the compactness of the breast in this age group is apt to obscure the tumor. This condition obtains to an even greater degree during pregnancy. This creates a discrepancy between the clinical and x-ray findings. The clinician palpates a movable, solid tumor, but the radiologist fails to visualize it. These circumstances in a young adult with an appropriate history are *prima facie* evidence of a fibroadenoma.

Since a fibroadenoma has the same density as normal breast tissue, there must be either a natural or an artificial medium of contrast before the tumor can be demonstrated. Fat is a natural contrast medium, and in those breasts where it is present, fibroadenoma becomes discernible. The greater the amount of

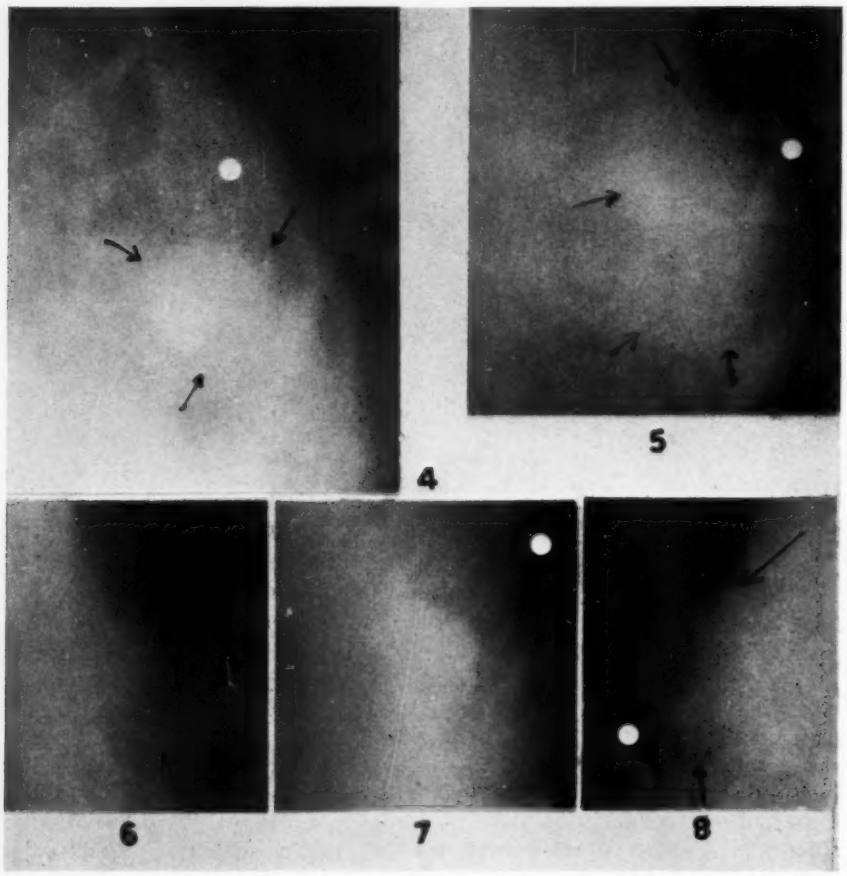

Fig. 4. Fibroadenoma. Patient aged 49. A lump in the upper outer quadrant of the right breast for two months, freely movable and nodular. At operation, a nodular tumor 1.5 cm. in diameter was removed. *Roentgenography:* A sharply defined tumor, 1.5 cm. in diameter, visible. Density almost similar to the surrounding mazoplastic breast. *Pathology:* Fibroadenoma. (Dr. N. Rothschild.)

Fig. 5. Fibroadenoma. Patient aged 45. A tender movable mass 2 cm. in diameter just above the areola in the right breast for three weeks. *Roentgenography:* Circumscribed ovoid tumor. Anterior margins definite; posterior surface merging with breast tissue. (Small lead shot marker can be seen affixed to skin by adhesive tape over nodule. Scotch tape is now used because it casts no shadow.) *Pathology:* Fibroadenoma, 3.5 × 2.5 cm., consisting of a conglomeration of nodules, merging on one side with the breast.

Fig. 6. Fibroadenoma. Patient aged 36. Tumor 2 cm. in diameter in upper outer quadrant of left breast for seven years. *Roentgenography:* Anterior outline of small mass protruding from surrounding breast tissue of similar density. *Pathology:* Nodule completely encapsulated. Microscopically, the tumor was a more or less degenerated fibroadenoma of the intracanalicular type. (Dr. E. Mendelssohn.)

Fig. 7. Fibroadenoma. Patient aged 33. Freely movable mass, 2 × 1 cm., in upper outer quadrant of left breast, for three years. *Roentgenography:* Isolated tumor with sharp anterior margin in the subcutaneous layer of fat. *Pathology:* Encapsulated tumor, 2.3 × 1.2 cm., consisting of a conglomeration of fibroadenomatous tissue.

Fig. 8. Fibroadenoma. Patient aged 25. Movable mass, 2 cm. in diameter, in upper outer quadrant of right breast, for two weeks. *Roentgenography:* Tumor sharply outlined anteriorly in layer of subcutaneous fat. Contour slightly bosselated. *Pathology:* Soft encapsulated tumor, 3 × 2 cm. A small cyst filled with altered blood was also present, as well as two other cysts. (Dr. B. Greenspan.)

fat, the easier the discernment. Since a subcutaneous layer of fat is present in all breasts, any tumor projecting into this layer becomes at least partly visible on the x-ray film.

Finally, in the older age groups, where atrophy of the parenchyma conjoins with increased fatty invasion of the breast, a clear visualization of the tumor occurs. The tumor density is then greater than

that of the perifocal tissues, and the sharp tumor margins, which are usually lobulated or bosselated, contrast well with the fatty tumor bed. Occasionally a giant fibroadenoma may develop, and by its very size make itself evident.

There are thus three degrees of discernment of fibroadenomata on the x-ray film.

(1) No visibility in the compact adolescent mazoplastic or pregnant breast (Figs. 1 and 2).

(2) Partial visibility where the tumor projects into the subcutaneous layer of fat or where there is sufficient fat invasion to serve for contrast purposes (Figs. 3–10).

(3) Complete visibility because of large tumor size or a high fat content of the breast (Figs. 11–15).

Many fibroadenomas undergo cystic or mucinous degeneration or calcification. Cartilage and even osseous tissue form in some of these tumors. Calcification, whether amorphous or architecturally reticulated as in bone, is easily seen on an x-ray film. In a fibroadenoma, it can assume all sorts of bizarre forms and is not readily confused with the scattered, fine punctate deposits of scirrhous carcinoma (Fig. 16).

Not infrequently, patients will discover a lump in one breast due to a fibroadenoma, and x-ray studies will reveal a tumor in the other breast as well (Figs. 3, 10, and 15).

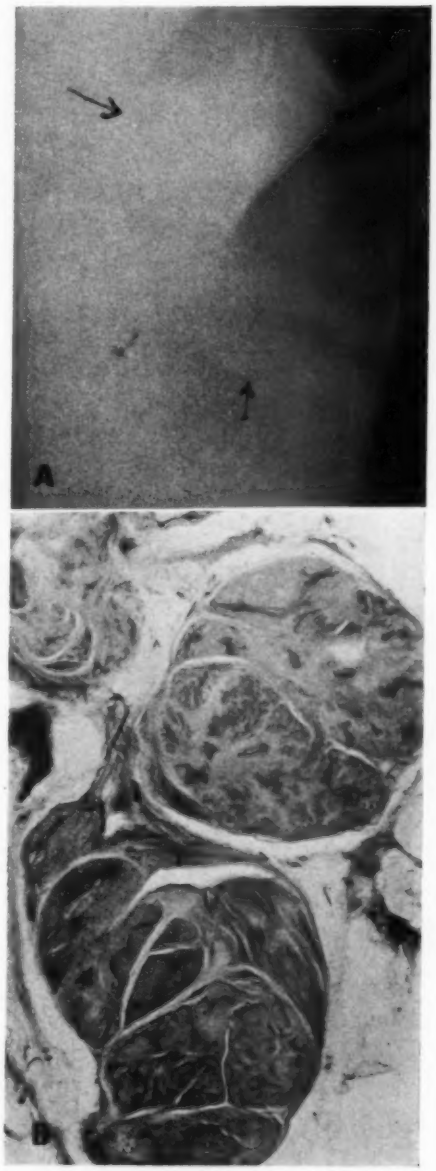

Fig. 9. Multiple fibroadenomas. Patient aged 25. Tumors in upper outer edge of right breast, present for two months; increase in size during menstruation. A similar mass was removed from the left breast three and a half years earlier. Breasts large and pendulous. Tumors palpable. *Roentgenography:* Three tumors clearly seen near axilla; all sharply outlined and smooth, resembling cysts. *Pathology:* Mass 6 × 2.5 cm., containing 3 encapsulated fibroadenomas.

DIFFERENTIAL DIAGNOSIS

(*a*) *Cysts:* Some of the above criteria for the diagnosis of fibroadenoma are equally applicable to cysts, thereby creating diagnostic difficulties. Moreover, the picture is further complicated by the fact that cysts may occur in fibroadenomas. When the differentiation between the two can be made, it is because cyst walls are smooth and without the bosselations of a fibroadenoma. Some cysts containing papillomas have a greater density than fibroadenomas of the same size. This is due to hemosiderin deposited as a result of hemorrhage from the growth.

When a group of cysts are present, the contour of the group may simulate the lobulated contour of a fibroadenoma.

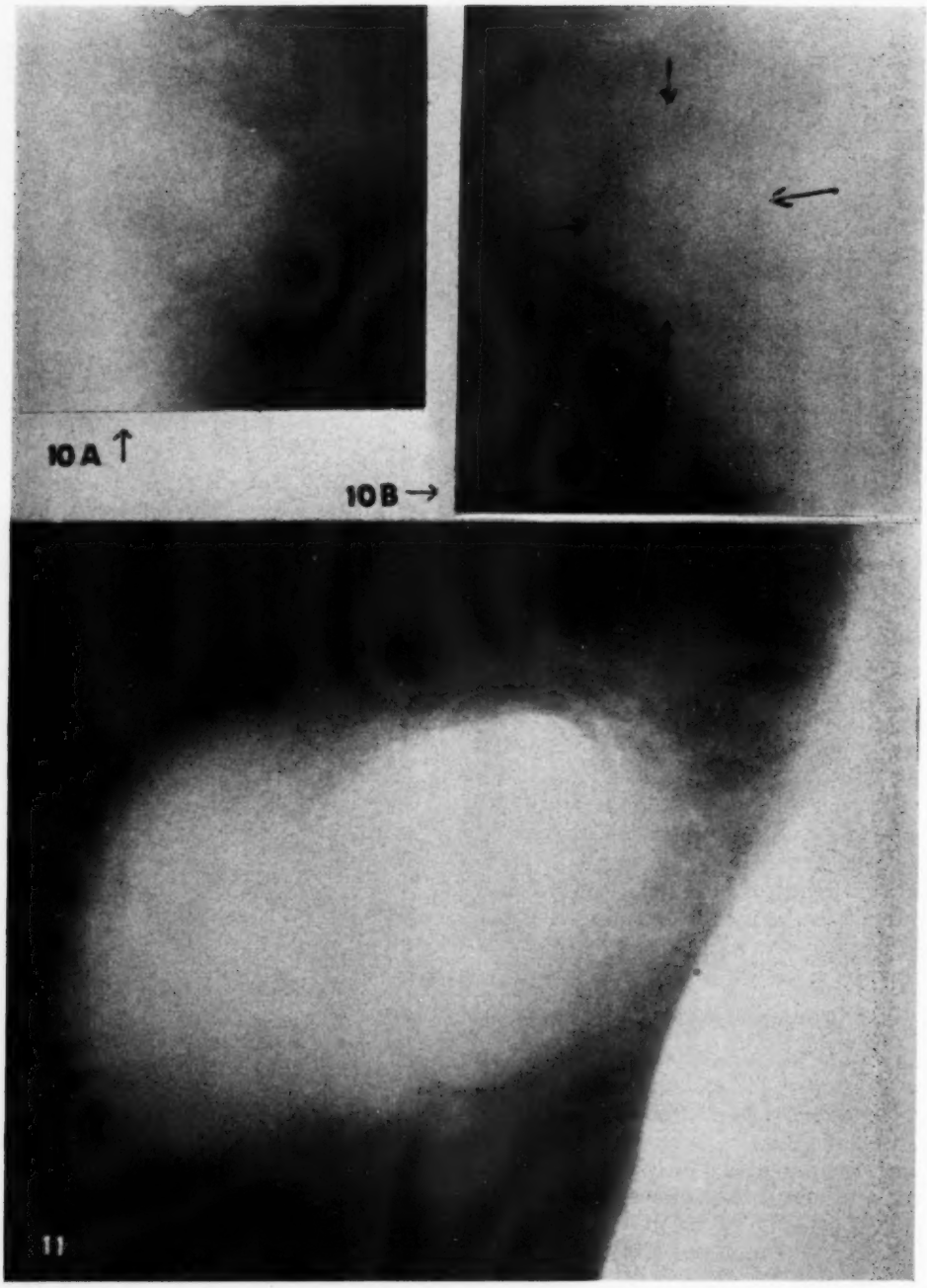

Fig. 10. Bilateral fibroadenomas. Patient aged 26. Lump in left breast for six months. The breasts contained similar tumors, each approximately 1.5 × 1.5 cm., situated in the lower outer quadrant of the right breast and the lower inner quadrant of the left breast, in homologous positions. *Roentgenography:* The tumors look much alike. They are faintly visible, bosselated masses surrounded by a halo due to compression of fat by the tumor. The trabeculae stream around the masses. *Pathology:* The right tumor (A) consisted of two well encapsulated fibroadenomas; the left (B) presented three fibroadenomas. Both were mainly of the intracanalicular type. They were formed of aggregations of nodules with variable patterns of growth.

Fig. 11. Giant fibroadenoma. Patient aged 47. Painless mass noted in the right breast for three weeks. A tumor was removed from same breast two years previously. *Roentgenography:* Large encapsulated mass, slightly bosselated. *Pathology:* Encapsulated firm nodular fibroadenoma, 7 × 5 × 4 cm.

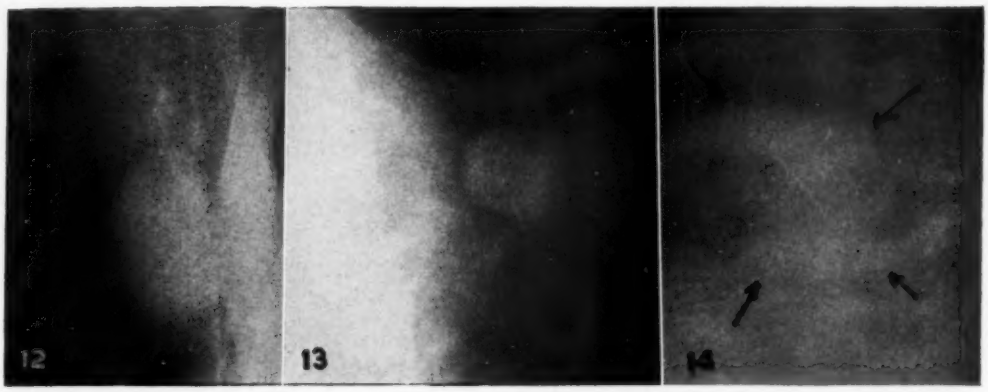

Fig. 12. Fibroadenoma. Patient aged 27. Tumor in the lower inner quadrant of the left breast for three months, increasing in size before menstruation and decreasing afterward. *Roentgenography:* Smooth contoured mass, with no distortion of tumor bed; margin is slightly bosselated. The tumor is surrounded by fat and is therefore visible. *Pathology:* Ovoid elastic mass, 3 × 2 × 2 cm., well encapsulated, with a few adherent fatty tabs. Microscopically, the tumor consists of a conglomeration of fibroadenomatous nodules of varying size and is intracanalicular in type.

Fig. 13. Fibroadenoma. Patient aged 39. Mass noted for three years in upper outer quadrant of left breast near nipple, about 1 cm. in diameter. This was palpable. *Roentgenography:* Sharply outlined tumor clearly visible in the subcutaneous fat. The outline is smooth, so that differentiation from a cyst is difficult. Cancer not suggested because no marginal spicules or tentacles are seen. *Pathology:* Completely encapsulated fibroadenoma. (Dr. M. Cullen.)

Fig. 14. Fibroadenoma. Patient aged 39. One year earlier the patient bumped her left breast, and a bruised area, "the size of a nickel," appeared on the medial surface. Ten months later, a freely movable lump was noted in the same area. This had increased progressively in size. Considerable swelling of the breast occurred before menstrual periods. *Roentgenography:* Sharply defined tumor with an irregular, bosselated contour, measuring 3 to 4 cm. in diameter. The perifocal stroma is pushed aside so that the mass appears surrounded by a clear zone or halo. The nipple is retracted, owing to tension on the subareolar trabeculae. The lobulated contour of this tumor distinguishes it from the smooth outline of a cyst, and absence of spicules differentiates it from carcinoma. *Pathology:* Encapsulated fibroadenoma measuring 4 cm. in diameter. (Dr. N. Rothschild.)

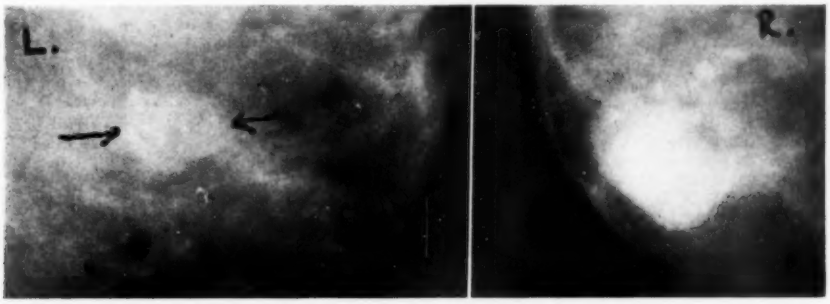

Fig. 15. Bilateral fibroadenomas in a patient aged 47. Small movable lumps in the lower portions of both breasts for several months. *Roentgenography:* Isolated sharply defined tumors. The density of the tumor in the left breast is like that of surrounding tissue, but the density of the tumor in the right breast is greater than the perifocal stroma; moreover, its anterior margins are sharply defined in the subcutaneous fat layer. *Pathology:* Both masses fibroadenomas.

Study of the entire breast will help in the diagnosis, since cysts are not seen in mazoplasia I. Familiarity with the appearance of the normal breast and with that of mazoplasia is required when using these criteria. In mazoplasia I, the breast is compact, its density is uniform, its margins are smooth, and there is no accentuation of Cooper's ligaments in the extensions traversing the subcutaneous fat layer. In mazoplasia II, characterized by cyst formation, the breasts are not uniform in density, the margins are curvilinear, and the extensions of Cooper's

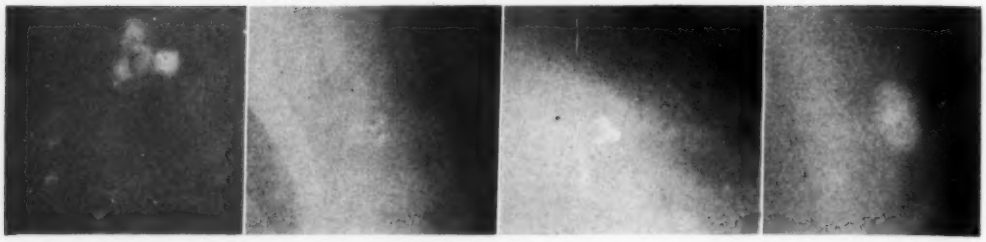

Fig. 16. Four examples of calcification in fibroadenomas.

Fig. 17. Cystic mazoplasia. Patient aged 41. A mass first noticed two days earlier in the center upper portion of the left breast. *Roentgenography:* The lesions in this film are difficult to distinguish from Schimmelbusch disease. The smooth, undulating margins of cysts protrude into the subcutaneous layer of fat. *Pathology:* Tumor 8 × 5 cm., containing numerous smooth-walled cysts, the largest of which is 4.5 cm. in diameter; lobules poorly developed. (Dr. M. Segal.)

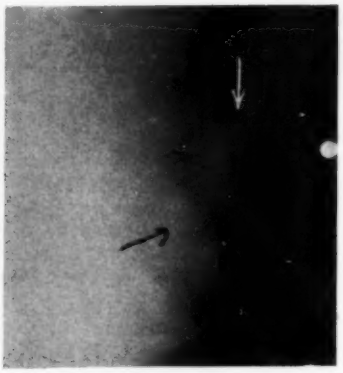

Fig. 18. Intraductal papilloma (malignant?). Patient aged 33. Soreness in right breast and discharge from nipple for two weeks. Both breasts nodular. Freely movable mass in right subareolar area. *Roentgenography:* Serpentine distortion of ducts in the region of the palpable mass indicated by lead shot on skin. The appearance is not that of carcinoma, since there are no radiations from the tortuous ducts, no obvious tumor bed, and no secondary signs of malignant growth.

First operative specimen, 5 cm. in diameter, consisted chiefly of minute gelatinous cysts. Microscopically the ducts were seen to be filled with papillomas or solid cores of cells.

Second operation, four days later: simple mastectomy. Breast showed a few moderately dilated ducts filled with cellular or papillomatous growth and a large number of poorly differentiated lobules. No carcinoma found outside ducts. (Dr. J. Zaslow.)

ligaments through the subcutaneous fat layer are thickened (Fig. 17). In cysts, calcification is rare; it is often seen in fibroadenomas.

(*b*) *Papilloma* may be suspected when an elongated tortuous subareolar duct is visualized. This appearance is not easily confused with that of a fibroadenoma (Fig. 18). If the papilloma is intracystic, its presence may be obscured by the cyst, but papilloma may be suspected if the density of the cyst suggests the presence of hemosiderin (Fig. 19).

(*c*) *Secretory cystic disease with plasma-cell mastitis* is more apt to be confused with mazoplasia II or carcinoma than with fibroadenoma. The flame-like stromal digitations streaming backward from the areolar area and the coarsely tentacled mass of plasma-cell mastitis present a sharp contrast to the compact breast with a sharply outlined but smoothly contoured fibroadenoma (Fig. 20).

(*d*) *Carcinoma:* The uniform density and the smooth margins of a fibroadenoma differentiate it from the spiculated or

tentacled margins of a malignant tumor. Rarely, a carcinoma may be dense, localized, and with margins so finely spiculated as to escape detection, thus simulating a fibroadenoma (Fig. 21; compare with Fig. 15). The secondary signs of malignant tumors, such as dimpling, retraction

Fig. 19. Cyst containing papilloma. Patient aged 59. History of trauma to the left breast a year earlier, and of a stationary lump in the breast a long time before that. Following the trauma there was sudden swelling of the breast, with a discharge of brownish fluid from the nipple. The swelling subsided but recurred two months prior to admission. Examination showed a huge swelling with discoloration of the skin in the upper outer quadrant of the left breast. The day before operation this broke through the skin, with a discharge of blood. *Roentgenography:* An enormous loculated cyst which, owing to contained blood, was much denser than usual. Contour of the breast distorted; breast parenchyma compressed; moderate increase in vascularity. *Pathology:* Enormous biocular cyst, 8 cm. in diameter, with bunches of papillomatous growth springing from wall. Remains of blood and necrotic material still present. Smaller similar cysts found nearby. No carcinoma. (Dr. F. Block.)

or edema of the skin are seldom seen in association with fibroadenoma. There is no increased vascularity of the perifocal tissues. The calcification which occurs in fibroadenoma is usually coarse and bizarre, and not finely granulated as in a malignant lesion. Fibroadenoma is apt to be found in the young mazoplastic

Fig. 20. Secretory cystic disease. Patient aged 41. Tumor in the upper outer quadrant of the right breast for six or seven weeks, becoming larger before menstrual periods and diminishing during the period. Two weeks before admission the mass became black and blue. There had been a lump in the left breast one year before, but it had disappeared. *Roentgenography:* Cysts resembling mazoplasia II. The tumor-like mass in the upper portion of breast presents flame-like radiations, due in part to hyperemia and in part to dilated ducts filled with secretion. *Pathology:* Specimen 5.5 × 4 × 2 cm. showed numerous cysts, most of which contained inspissated secretion. One area revealed plasma-cell mastitis.

breast, while cancer is more commonly found in the adult or senile breast (Fig. 22).

SUMMARY

1. Fibroadenomas of the breast are of frequent occurrence in the adolescent or young adult. In these age groups the breasts are apt to be mazoplastic, compact, dense, and smoothly contoured.

2. Since the density of a fibroadenoma is precisely that of mammary tissue, it can be seen in an x-ray film only if partially or completely surrounded by fat, whether it be in the subcutaneous fat layer or in the fat infiltrations of the breast proper. A palpable tumor in an adolescent or young adult not seen on the x-ray film is apt to be a fibroadenoma.

3. The density of fibroadenoma is uniform; the margins are smooth; the contour is often lobulated or bosselated; the perifocal tissues are pushed aside rather than invaded. A fibroadenoma is apt to

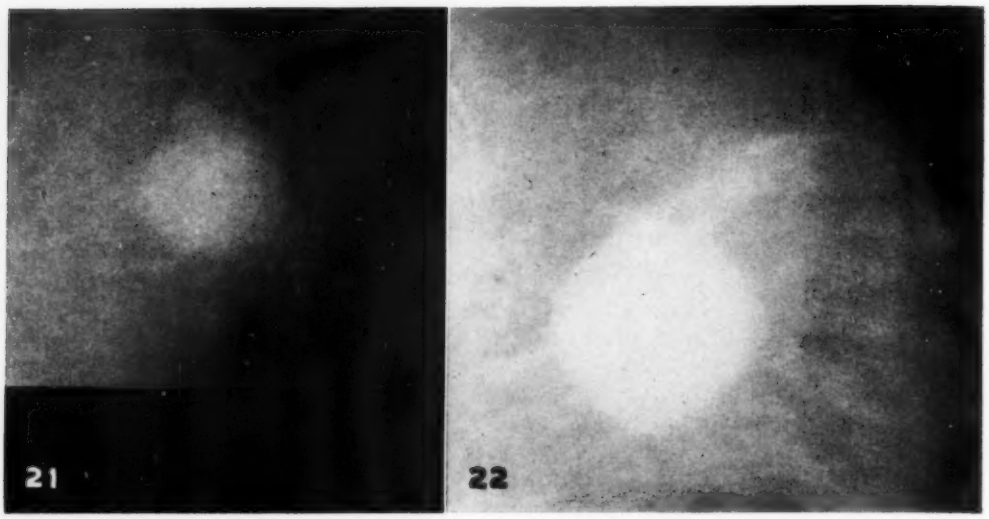

Fig. 21. Localized carcinoma. Patient aged 54. A painless mass, 12 cm. in diameter, noted one week earlier in the upper outer quadrant of the right breast. No skin changes and no axillary nodes were found. *Roentgenography:* Isolated tumor with spiculated margins. *Pathology:* Alveolar carcinoma. (Compare with Figure 14.)

Fig. 22. Infiltrative carcinoma of left breast. Patient aged 42. "Drawing" sensation in the nipple for four or five months. After two months a physician was consulted, but no tumor was found. Three weeks later the patient discovered a hard mass, 4 cm. deep, in the lower inner quadrant. *Roentgenography:* Tumor very easily seen, owing to fatty tumor bed. Margin finely spiculated (fine details lost in reproduction); much perifocal fibrosis. *Pathology:* Carcinoma, 3 cm. in diameter.

resemble a cyst rather than carcinoma or any other disease of the breast.

4. The calcification sometimes seen in fibroadenoma tends to be irregular, coarse, and bizarre.

5. Fibroadenomas often occur in both breasts, although symptoms may be localized to one side.

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SUMARIO

La Roentgenografía del Fibroadenoma de la Mama

Para el diagnóstico roentgenológico del fibroadenoma mamario, se toman vistas laterales y tangenciales de cada mama. Las pautas diagnósticas se sumarizan así:

1. Los fibroadenomas mamarios son frecuentes en la adolescencia y la juventud, a cuyas edades las mamas suelen ser mazoplásticas, compactas, gruesas y de contornos lisos.

2. Como el espesor de un fibroadenoma es precisamente igual al del tejido mamario, no puede ser observado en una radiografía a menos que esté total o parcialmente rodeado de tejido adiposo, ya sea en la capa

adiposa subcutánea o en las infiltraciones grasas de la mama misma. Un tumor palpable en una adolescente o joven que no aparezca en la radiografía es susceptible de ser fibroadenoma.

3. La densidad del fibroadenoma es uniforme; los bordes son lisos; el contorno es a menudo lobulado o lleno de protuberancias; los tejidos perifocales están desviados más bien que invadidos. Un fibroadenoma se parecerá probablemente más a un quiste que a carcinoma.

4. La calcificación observada a veces en el fibroadenoma suele ser irregular, tosca y caprichosa.

5. Los fibroadenomas afectan a menudo ambas mamas, aunque los síntomas pueden estar localizados en un lado.

Errors of Diagnosis in Mass Radiography[1]

L. E. POWERS, M.D.,[2] and Wm. S. LAINHART, M.D.[3]

WITHIN THE last ten years probably more than a third of the adult population of the United States has had some type of x-ray examination of the chest through mass surveys. In a comparison of the effectiveness of the various roentgenographic and photofluorographic methods in tuberculosis case finding (Birkelo *et al.*, 1, and Yerushalmy, 2), the conclusion was reached that, "except for a slight disadvantage to the miniature technics resulting from over-reading, not one of the methods, not even the 14 × 17-inch celluloid, is superior, for case finding purposes, to any of the other methods." This conclusion was based on a comparative reading of films by five experts, representing the problem of inter-individual and intra-individual variations in interpretation.

The present study is concerned with errors in the "tentative" diagnostic interpretations of 70-mm. photofluorograms and in the "presumptive" diagnostic interpretations of 14 × 17-inch roentgenograms (in persons screened by 70-mm. film), as revealed by comparison with clinical diagnoses based on two years of observation and/or treatment. The definitive clinical diagnosis was obtained from information supplied by the attending physician or clinic two years after the mass x-ray survey conducted in Tacoma, Wash., in February 1949 (3).

There were available for study records of 506 patients from a total of 677 with definite abnormalities discovered photofluorographically, for whom follow-up was recommended after further screening with 14 × 17-inch roentgenograms.[4] The tentative diagnoses made from the miniature (70-mm.) films were as follows:

Tuberculosis (all stages)	152
Suspected tuberculosis	213
Cardiac abnormality	67
Other chest lesions	68
Unsatisfactory film	6

A group of roentgenologists reading the miniature survey films classified 152 cases as "tentatively tuberculosis" (all stages included). Of these 152 cases, 144 were found clinically to be tuberculosis, representing an error of 5.3 per cent (Table I). In the same 152 cases the diagnosis "presumptively tuberculosis" was made from the 14 × 17-inch films on 142 patients.

TABLE I: LARGE (14 × 17-INCH) FILM "PRESUMPTIVE" DIAGNOSES AND FINAL CLINICAL DIAGNOSES (AFTER TWO YEARS OBSERVATION AND/OR TREATMENT) IN 152 CASES WITH "TENTATIVE" DIAGNOSES OF TUBERCULOSIS ON 70-MM. PHOTOFLUOROGRAMS

Large Film Reading Presumptive Diagnosis	Final Clinical Diagnoses After 2 Years: Tuberculosis	Cardiac	Other Pathology	Clinically Negative	Percentage of Error 14×17-in. Film	Percentage of Error 70-mm. Film
Tuberculosis 142	139	0	3	0	2.1	4.0
Suspected tuberculosis 7	4	0	3	0	42.7	
Cardiac 1	0	0	1	0	100.0	
Other chest pathology 2	1	0	1	0	50.0	
TOTAL 152	144	0	8	0		5.3

[1] Accepted for publication in October 1951.

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[4] The remaining 171 were excluded for the following reasons: (*a*) 110 patients were "lost" at the time of the survey for follow-up studies; (*b*) the authors received no follow-up information from the practising physician in 37 cases; (*c*) no diagnosis was possible in 24 cases.

TABLE II: LARGE (14 × 17-INCH) FILM "PRESUMPTIVE" DIAGNOSES AND FINAL CLINICAL DIAGNOSES IN 213 CASES WITH "TENTATIVE" DIAGNOSES OF SUSPECTED TUBERCULOSIS ON 70-MM. PHOTOFLUOROGRAMS

Large Film Reading Presumptive Diagnosis	Final Clinical Diagnoses After 2 Years				Percentage of Error 14 × 17-in. Film	Percentage of Error 70-mm. Film
	Tuberculosis	Cardiac	Other Pathology	Clinically Negative		
Tuberculosis..... 105	96	2	6	1	8.6	20.2
Suspected tuberculosis..... 98	66	1	15	16	32.6	
Cardiac..... 0	0	0	0	0	0	
Other pathology..... 10	4	1	5	0	50.0	
TOTAL.....213	166	4	26	17		22.1

TABLE III: LARGE (14 × 17-INCH) FILM "PRESUMPTIVE" DIAGNOSES AND FINAL CLINICAL DIAGNOSES IN 67 CASES WITH "TENTATIVE" DIAGNOSES OF CARDIAC DISEASE ON 70-MM. PHOTOFLUOROGRAMS

Large Film Reading Presumptive Diagnosis	Final Clinical Diagnoses After 2 Years				Percentage of Error 14 × 17-in. Film	Percentage of Error 70-mm. Film
	Tuberculosis	Cardiac	Other Pathology	Clinically Negative		
Tuberculosis..... 0	0	0	0	0	0	
Suspected tuberculosis..... 0	0	0	0	0	0	
Cardiac.....67	0	59	4	4	11.9	
Other pathology..... 0	0	0	0	0		
TOTAL.....67	0	59	4	4		11.9

When these 142 cases were evaluated clinically, 139 were diagnosed as tuberculosis at the end of the two-year period, the error in this instance being 2.1 per cent. If, however, we consider the large film diagnosis of 142 tuberculosis and 7 suspected tuberculosis (total 149), and the 139 and 4 diagnosed clinically as tuberculosis and suspected tuberculosis (total 143), the error is 4.0 per cent. The errors in the other diagnostic categories are listed in Table I.

Two hundred and thirteen cases tentatively classified as suspected tuberculosis were recorded from the 70-mm. films. Of these, 98 were still classified as suspected tuberculosis on the basis of the large films, while 105 were regarded as tuberculosis, and 10 were diagnosed as "other chest pathology" (Table II). Only 166 of the cases diagnosed from the miniature films were considered clinically to be tuberculosis, representing an error of 22.1 per cent. Of the 105 cases diagnosed by the 14 × 17-inch film, 96 were considered clinically to be tuberculosis, giving an error of 8.6 per cent. If we compare the large-film diagnoses of 105 tuberculosis and 98 suspected tuberculosis (total 203) with 96 and 66 clinical diagnoses, respectively (total 162), the error is found to be 20.2 per cent. The errors in the other diagnostic categories are presented in Table II.

All of the 67 diagnoses of "cardiac" disease on the basis of the miniature films were sustained by examination with 14 × 17-inch film. In the final clinical evaluation, the diagnosis was upheld in 59 of the 67 cases (Table III).

Of the 68 cases with the reading "other chest pathology" on the 70-mm. film, the diagnosis was sustained in 39 on large film examination and 37 clinically. It is interesting to note that 24 clinical cases of tuberculosis were missed with the small films and 8 of the 39 cases with the interpretation on the large film as "other chest pathology" were finally considered to be tuberculosis (Table IV).

Of the 6 cases for which the 70-mm. films were unsatisfactory, 4 were diagnosed from the 14 × 17-inch films as tuberculosis, 1 as suspected tuberculosis, and 1 as other chest pathology. The final clinical diagnoses were 5 tuberculosis and 1 cardiac disease.

TABLE IV: LARGE (14 × 17-INCH) FILM "PRESUMPTIVE" DIAGNOSES AND FINAL CLINICAL DIAGNOSES IN 68 CASES WITH "TENTATIVE" DIAGNOSES OF OTHER CHEST PATHOLOGY ON 70-MM. PHOTOFLUOROGRAMS

Large Film Reading Presumptive Diagnosis	Final Clinical Diagnoses After 2 Years: Tuberculosis	Cardiac	Other Pathology	Clinically Negative	Percentage of Error 14 × 17-in. Film	Percentage of Error 70-mm. Film
Tuberculosis.....11	11	0	0	0	0 } 40.7	
Suspected tuberculosis.....16	5	1	8	2	68.7 }	
Cardiac.....2	0	2	0	0	0	
Other pathology.....39	8	2	29	0	25.6	
TOTAL.....68	24	5	37	2		45.0

TABLE V: TOTAL ERRORS IN "TENTATIVE" (70-MM. PHOTOFLUOROGRAMS) AND "PRESUMPTIVE" (14 × 17-IN. FILM) DIAGNOSES ON BASIS OF FINAL CLINICAL DIAGNOSES

Roentgen Diagnoses	Final Clinical Diagnoses After 2 Years: Tuberculosis	Cardiac	Other Pathology	Clinically Negative	Errors	
70-mm. Reading						
Tuberculosis.....152	144	0	8	0	8 (5.3%) }	15%
Suspected Tuberculosis....213	166	4	26	17	47 (22.1%) }	
Cardiac.....67	0	59	4	4	8 (11.9%)	
Other Pathology.....68	24	5	37	2	31 (45.6%)	
Unsatisfactory Films.....6	5	1	0	0	0	
TOTAL.....506	339	69	75	23	94 (18.6%)	
14 × 17-in. Reading						
Tuberculosis.....262	250	2	9	1	12 (4.6%) }	12%
Suspected Tuberculosis....122	76	2	26	18	46 (37.7%) }	
Cardiac.....70	0	62	4	4	8 (11.4%)	
Other Pathology.....52	13	3	36	0	16 (30.8%)	
TOTAL.....506	339	69	75	23	82 (16.2%)	

When a tabulation of the total errors is made (Table V), it will be seen that among the 506 cases considered in this study, there was an 18.6 per cent overall error (94 wrong diagnoses) in the tentative photofluorographic diagnosis of tuberculosis as compared with clinical evaluation; while the error in the 14 × 17-inch film diagnoses as compared with the clinical diagnosis was 16.2 per cent (82 errors) (Table V).

On the basis of statistical consideration of the percentage of errors with the 70-mm. and the 14 × 17-inch films, there appears to be no significant difference between readings of the two types with respect to the final clinical diagnosis.

Table VI lists the final clinical diagnosis of those cases for which the 14 × 17-inch films (11 diagnosed as tuberculosis and 46 as suspected tuberculosis) were reported as indicative of tuberculosis, but which apparently were finally determined not to be tuberculosis.

DISCUSSION AND CONCLUSIONS

The 677 persons (506 included in this study) who were recommended for further clinical study after the reading of the 14 × 17-inch roentgenograms by a group of roentgenologists and cardiologists were selected from 1,462 persons previously screened as presenting some abnormality on 70-mm. photofluorograms. The 1,462 miniature films were selected from the 72,703 obtained in the 1949 mass survey conducted in Pierce County, Washington (3).

The over-reading of the 70-mm. films in this survey is typical of experience with any type of miniature film screening. An attempt was made to determine whether, in spite of this over-reading, any cases of tuberculosis had been missed.

TABLE VI: CLINICAL DIAGNOSES MADE BY PRIVATE PHYSICIANS AND THE TACOMA-PIERCE COUNTY HEALTH DEPARTMENT ON PATIENTS WHOSE ROENTGENOGRAMS (14 × 17-INCH) WERE REPORTED AS INDICATIVE OF TUBERCULOSIS APPARENTLY IN ERROR

Campaign Diagnosis	Clinical Diagnosis	Number	
Suspected tuberculosis	No significant pathology present	18	
	Asthma and bronchitis	2	
	Bronchitis	1	
	Calcified pleural plaque, etiology unknown	1	
	Coronary artery disease, no other lung pathology	1	
	Histoplasmosis	1	
	Miliary carcinomatosis (primary: stomach)	1	
	Pleural thickening, etiology unknown	3	
	Pleurisy, etiology unknown	3	
	Pulmonary fibrosis, etiology unknown	6	
	Pulmonary edema, secondary to arteriosclerotic heart disease	1	
	Sarcoidosis	3	
	Silicosis	5	
			46
Minimal tuberculosis	Asthma and bronchitis	1	
	Bronchiectasis	1	
	Fibrosis following radiation for carcinoma of the breast	1	
	Myocardial infarction, left ventricular failure	1	
	Myocardial degeneration, coronary thrombosis	1	
	Pericarditis, basal bronchiectasis	1	
			6
Moderately advanced tuberculosis	No significant pathology present	1	
	Atelectasis, etiology unknown	1	
	Bronchitis	1	
	Pulmonary fibrosis, etiology unknown	1	
			4
Far advanced tuberculosis	Silicosis	1	
			1
	TOTAL		57

During the two year period following the mass survey, 254 new cases of tuberculosis were reported to the Tacoma-Pierce County Health Department. Upon investigation, it was found that only 2 of the 254 patients had been filmed during the mass survey. The diagnosis in both cases was "early minimal tuberculosis." It would thus appear that the number of "missed cases" of tuberculosis with the current miniature photofluorographic mass screening technic is insignificant. However, it would also appear that many persons who suspect they may have tuberculosis do not submit to examination during a mass survey.

From the data presented, one could expect an error of 10 to 15 per cent in the diagnoses of tuberculosis made by a group of roentgenologists and cardiologists from 14 × 17-inch chest roentgenograms.

Except for the over-reading of the 70-mm. films, no significant quantitative difference is demonstrated in the errors of reading between the 70-mm. and the 14 × 17-inch films as determined by the definitive clinical diagnosis.

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SUMARIO

Errores de Diagnóstico en la Radiografía Colectiva

Obtúvose un diagnóstico clínico final (al cabo de dos años de observación y/o tratamiento) para 506 personas, de un número mayor recomendadas para estudios ulteriores después de encuestas con roentgenofotografías de 70 mm. y de lecturas subsiguientes de radiografías de 35 × 52.5 cm. A juzgar por los datos presentados, cabe esperar un error de 10 a 15 por ciento en el diagnóstico de tuberculosis pulmonar formulado por un grupo de radiólogos y cardiólogos a base de las radiografías de 35 × 52.5 cm.

Aparte de la exagerada interpretación de las películas de 70 mm., este estudio no reveló ninguna importante diferencia cuantitativa en los errores de lectura entre las radiografías de 70 mm. y las de 35 × 52.5 cm., en lo que determinara el diagnóstico clínico definitivo.

A Roentgen Study of the Effect of Total Pancreatectomy on the Stomach and Small Intestine of the Dog[1]

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NUMEROUS AND extensive studies (1, 2, 3, 5, 7, 10, 12–15) of extrinsic and intrinsic influences upon the radiologic appearance of the small intestine have revealed that, though the small bowel is sensitive to a multitude of stimuli, it reacts in a limited manner. The finding of an altered motor pattern can therefore rarely be attributed to a definite entity. Limitations of the small-intestinal roentgen examination will continue until the stimuli and the motor changes they produce are more fully understood.

Among the factors requiring further study are the internal and external secretions of the pancreas. Loss of external secretions results in partially digested food products, principally proteins and fats. At least some of these products are felt to have a profound influence upon intestinal motor function (8, 15, 16). While these indirect effects of pancreatic enzymes upon the intestinal tract seem established, the direct effects, as measured by an inert water-barium meal, remain to be determined. It is the purpose of this investigation to study the results of exclusion of the internal and external pancreatic secretions upon the gastro-intestinal tract.

MATERIALS AND METHODS

Sixteen adult dogs (Table I), after a period of observation on a routine kennel diet, were subjected to complete pancreatectomy by Dr. Jonathan E. Rhoads of the Department of Research Surgery (University of Pennsylvania). Following this, the animals were maintained on a special diet consisting of 20 per cent casein, 10 per cent lard, 66 per cent sucrose, and 4 per cent salt, supplemented with essential vitamins. Insulin was administered according to requirements as indicated by glycosuria. Two dogs (Nos. 577 and 578) not depancreatized, served as controls.

All examinations were performed as follows: The dogs were fasted for at least three hours. A tube was passed into the stomach and 100 c.c. of a mixture of equal parts, by volume, of barium sulfate and distilled water was introduced. The tube was then withdrawn and the dog released. Radiographs were made at twenty-minute and fluoroscopic examinations at forty-minute intervals, the dogs being held immobile in the prone position. At all other times the animals were free of restraints. Two or three blood samples were obtained at equally spaced intervals during the post-pancreatectomy examinations for blood sugar determinations.

The effect of the blood sugar level on gastric emptying time, tone, and motility, and on small intestinal transit time, tone, and continuity of pattern was studied postoperatively during periods of hyperglycemia (insulin omitted on the morning of the examination), and of hypoglycemia (insulin administered two hours before the examination).

Gastric emptying time was taken as the interval from the time of instillation of the barium until the stomach was empty, *i.e.*, when no barium could be seen within the stomach or when only a coating of barium remained on the walls. The size and configuration of the stomach were

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used as measures of gastric tone, as was the depth of peristalsis noted on fluoroscopic examination. Motility was evaluated as to continuous or discontinuous emptying.

Continuity of the barium column in the lumen of the small intestine served as an indication of integrated function of its different segments. A discontinuous or fragmented barium column was considered an indication of lack of integrated functioning of the different portions of the small intestine. The term "discontinuous" is used to describe a column that remained uninterrupted except for clear-cut breaks, which left relatively long segments intact, while the term "fragmented" denotes a column broken into small segments by numerous gaps. Discontinuity was a normal observation in all examinations as individual segments of bowel emptied. To exclude this normal occurrence from the analysis, continuity was judged when it was obvious that the portion of bowel was not in the process of emptying.

TABLE I: GASTRIC EMPTYING TIME AND SMALL-INTESTINAL TRANSIT TIME OF NORMAL DOGS

Dog Number	Gastric Emptying Time (minutes)	Small-Intestinal Transit Time (minutes)
581	60	180
890	40	160
579	160*	160
578	140	160
314	40	160
580	80	140
851	40	140
314	140	140
577	180*	140
577	100	140
892	120*	120
189	180*	120
890	40	100
911	120	100
635	80	100
635	40	100
580	200	100
98	20	100
232	80	800
189	150	60
100	?	60
911	40	60
251	80	60
Median	80	120

* Stomach was not empty when examination was terminated.

TABLE II: GASTRIC EMPTYING TIME (G.E.T.) AND SMALL-INTESTINAL TRANSIT TIME (S.I.T.T.) OF CONTROL DOGS BEFORE AND AFTER INSTITUTION OF SPECIAL DIET

Dog Number	Stock Diet		Special Diet	
	G.E.T.	S.I.T.T.	G.E.T.	S.I.T.T.
577	100	140	80*	80
	180*	140	80*	80
			80	80
			180	120
			120	160
578	140	160	120*	80
			120	80
			100	100
			220*	120
			140*	140
			200*	140

* Stomach was not empty when examination was terminated.

RESULTS

A. Unoperated Animals

1. Stock Kennel Diet (Table I). *Stomach:* The median value of the gastric emptying times in unoperated animals maintained on a stock diet was 80 minutes, with extremes at 20 and 200 minutes. Values obtained in this group were used as normals for comparisons with those dogs that were examined postoperatively only. No alterations of shape, such as spasm or distention, were noted in the stomach, and gastric emptying was a continuous process.

Small Intestine: The small-intestinal transit time varied from 60 to 180 minutes, with 120 minutes as both the median and the average value. The barium column was continuous and of uniform caliber in all but one of the 23 examinations. The exception occurred in the first examination of a very timid dog, which was extremely fearful throughout the procedure. On subsequent examination, this dog was much less fearful and the intestinal pattern showed a continuous column. The one discontinuous column, therefore, seems adequately explained. The usual width of the jejunum varied from 4 to 12 mm., with a median value of 6 mm. The usual width of the ileum varied from 4 to 14 mm., with a median value of 7 mm.

Colon: The width of the cecum was measured on first filling when possible. Variations from 10 to 26 mm. occurred, with a median value of 16 mm.

TABLE III: GASTRIC EMPTYING (G.E.T.) AND SMALL-INTESTINAL TRANSIT TIME (S.I.T.T.) OF DOGS BEFORE AND FOLLOWING PANCREATECTOMY

Dog Number	Preoperative		Postoperative			
	G.E.T. (min.)	S.I.T.T. (min)	Postoperative day	Blood Sugar (mg. per cent)*	G.E.T. (min.)	S.I.T.T. (min.)
232	80	80	95	29	80	40
			14	37	40	120
			23	44	60	?
			106	205	180	220
			21	460	300	300
			60	461	240	240
251	80	60	63	35	140	100
			41	41	100†	60
			29	41	40	40
			47	321	320†	280
			78	355	320†	160
			13	362	100	160
314	140	140	42	34	40†	40
	40	160	20	39	80	180
			36	259	400†	400†
			19	300	460†	460†
			32	327	280†	200
181	Not examined		25	c‡	80	80
			32	c‡	120	80
			84	22	60	60
			40	28	40	80
			87	297	120†	120
			67	330	220†	220
			96	331	160†	160
428	Not examined		20	43	60	80
			28	295	280†	280
907	Not examined		16	c‡	60	260
			21	c‡	140	180
			65	38	40	240
			52	270	280†	260
			30	277	260†	240
			44	297	300†	320

* Blood sugar values obtained by Somogyi precipitation method with Folin Wu sugar determination. Normal values 70 to 100 mg. per 100 ml.

† Stomach was not empty, or cecum not reached, when examination was terminated.

‡ Indicates insulin was given but blood sugar was not determined.

2. Special Diet (Control Dogs) (Table II). *Stomach:* One (No. 578) of the two control dogs showed a tendency toward delay in gastric emptying in 4 of 6 examinations following the change to the special diet. The remaining animal (No. 577) showed no significant difference. In both animals gastric tone and continuity of emptying were similar before and after institution of the special diet.

Small Intestine: The change to the special diet had no effect upon the small-intestinal transit time or small-intestinal tone of either control dog. The continuity of the small-intestinal pattern was not altered in one dog (No. 577), but in the other (No. 578), which had shown a prolonged gastric emptying, there was a discontinuous and fragmented pattern in five of six examinations.

Colon: The width of the proximal colon was not altered by the change to the special diet.

B. Postoperative (Pancreatectomy) Examinations

1. Blood Sugar Elevated (Table III; Figs. 1 and 2). *Stomach:* Following pancreatectomy, gastric emptying time was prolonged in each dog during the period of

hyperglycemia. The median value was 280 minutes, with extremes at 100 and 460 minutes, as compared to 80 minutes with extremes of 40 and 140, before pancreatectomy. The gastric emptying was usually continuous but very slow. Occasionally the stomach would empty partially and then lie dormant for long periods of time. Frequently the peristaltic waves, at first deep successive waves as in the normal stomach, quickly became slow and shallow.

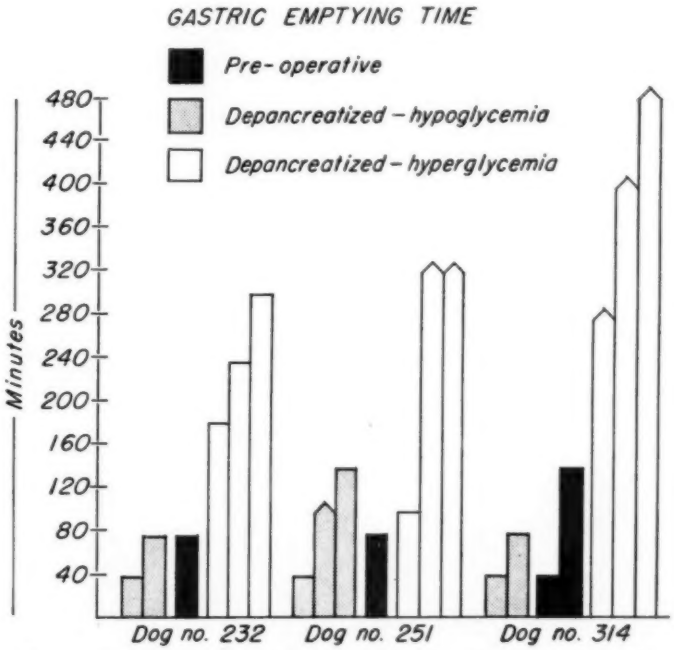

Fig. 1. Gastric emptying time of three dogs examined before pancreatectomy, following pancreatectomy with a low blood sugar, and following pancreatectomy with a high blood sugar. Pointed columns indicate stomach was not empty when examination was terminated.

In one dog (No. 181) marked loss of gastric tone was evident postoperatively when the blood sugar was elevated, and the stomach appeared large and sack-like. This also occurred in one examination of another dog (No. 251), under the same conditions. Otherwise the stomach was of normal size and configuration in all 6 animals when the blood sugar was elevated.

Small Intestine: The small-intestinal transit time was prolonged in each dog. The median value was 240 minutes (120 to 460 minutes), as compared to a median of 110 (60 to 160) minutes preoperatively. The delay was observed to be greater in the ileum than in the jejunum.

Continuity of the small-intestinal column was essentially unchanged in 35 of 37 examinations, regardless of the concentration of the blood sugar. In the remaining 2 instances the barium column was discontinuous during periods of hyperglycemia (Table IV).

No difference in the tone of the small intestine was noted.

2. Blood Sugar Low (Table III; Figs. 1 and 2). *Stomach:* The gastric emptying time in the 3 dogs studied both before and after pancreatectomy showed no consistent trends postoperatively during periods of hypoglycemia. In one animal (No. 232) it was decreased in 2 of 3 examinations; in another (No. 251) it was increased in 2 and

decreased in the third of three examinations. In the third dog (No. 314), also, no consistent change was noted. The median gastric emptying time for all 6 animals during periods of low blood sugar was 60 (40 to 140) minutes as compared to the level of the blood sugar. Transit was, however, uniformly delayed as compared to the median transit time of the preoperative examinations (Table I). This animal persisted in eating foreign materials, and in all examinations an opaque substance,

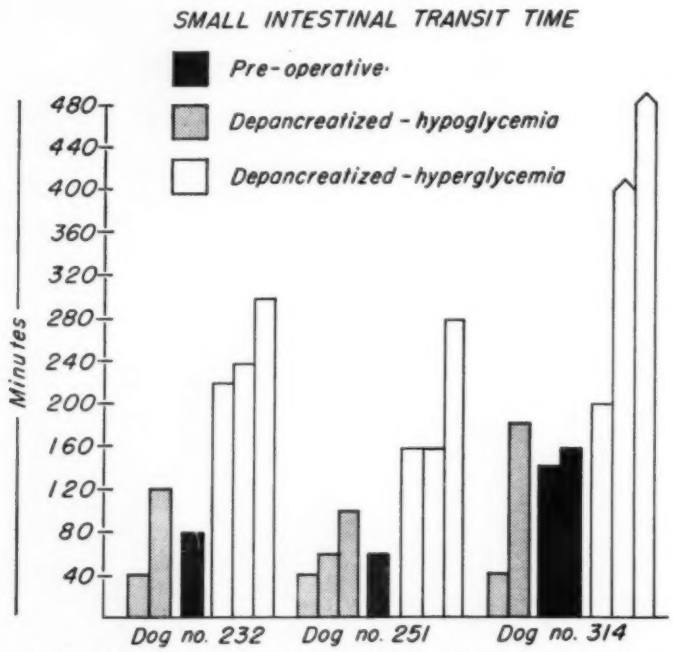

Fig. 2. Small-intestinal transit time of three dogs before pancreatectomy, after pancreatectomy with a low blood sugar, and after pancreatectomy with a high blood sugar. Pointed columns indicate cecum had not been reached when examination was terminated.

a median preoperative time of 80 (40 to 140) minutes and a median of 280 (100 to 460) minutes during the periods of hyperglycemia following pancreatectomy.

Gastric emptying was continuous, and no alteration from the normal size and configuration of the stomach was observed.

Small Intestine: No significant change in the small-intestinal transit time was noted as compared to the preoperative examinations. The median small-intestinal transit time was 80 (40 to 260) minutes as compared to a pre-pancreatectomy median value of 110 (60 to 160) minutes. One dog (No. 907), not examined preoperatively, had the same rate of small-intestinal transport regardless of thought to be paint, was visualized in the stomach. The ingested materials did not appear to delay gastric emptying but may have been responsible for the delayed small-intestinal transit. As indicated in Figure 3, gastric emptying time and small-intestinal transit time were unrelated in normal dogs.

In the depancreatized dogs during hypoglycemia gastric emptying time was again unrelated to small-intestinal transit time, whereas both gastric emptying and small-intestinal transit were prolonged postoperatively when the blood sugar was high (Fig. 4).

The appearance of the gastro-intestinal tract under the conditions of the experi-

ment are illustrated in Figures 5 and 6. Figure 5 demonstrates the gastro-intestinal tract of a depancreatized dog with a low blood sugar, a normal dog, and a depancreatized dog with an elevated blood sugar. Figure 6 shows the gastro-intestinal tract of dog No. 314, with a low, a normal, and a high blood sugar. No pattern distinctive of any of these conditions is evident; the only variant is the rate of motility.

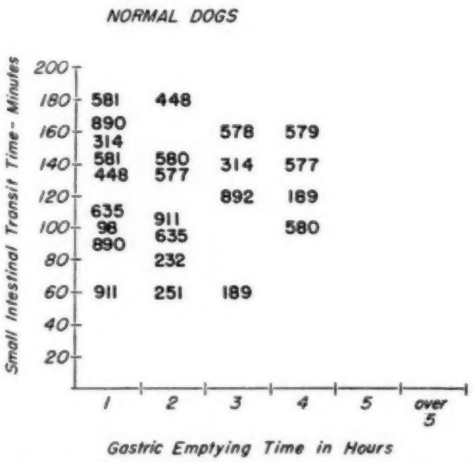

Fig. 3. Scatter diagram of gastric emptying time and of small-intestinal transit time of normal dogs, showing them to be unrelated.

DISCUSSION

Roentgen studies of the gastro-intestinal tract are evaluated on the basis of categories of response in an effort to attain greater objectiveness. Accepted categories include: the time required for the stomach to become empty; the time required for the test meal to traverse the small intestine; the width of the lumen as an indication of tone; and the continuity of

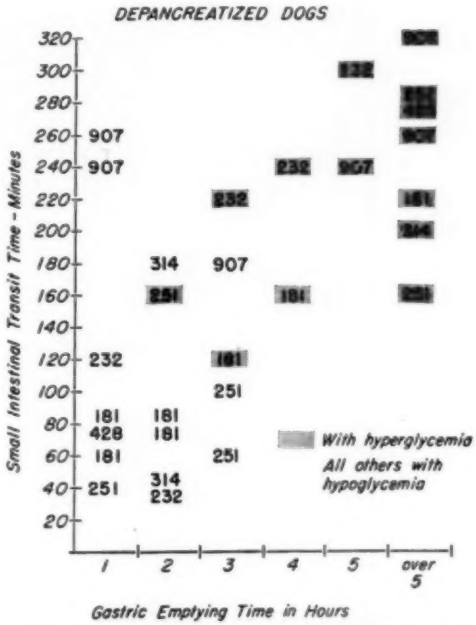

Fig. 4. Scatter diagram of gastric emptying time and of small-intestinal transit time of depancreatized dogs. In examinations made during hypoglycemia the two are unrelated, in the examinations during hyperglycemia both gastric emptying time and small-intestinal transit time are prolonged.

TABLE IV: CONTINUITY OF SMALL-INTESTINAL PATTERN OF DEPANCREATIZED DOGS BEFORE AND AFTER OPERATION, AND OF CONTROL DOGS BEFORE AND AFTER CHANGE OF DIET

	Continuous	Discontinuous	Fragmented	Continuous	Discontinuous	Fragmented
	Stock Diet			Special Diet		
Normal Dogs	22	0	0			
Control Dogs						
No. 577	2	0	0	5	0	0
No. 578	1	0	0	1	2	3
Experimental Dogs	Preoperative			Postoperative		
No. 232	1	0	0	7	1*	0
No. 251	1	0	0	5	1†	0
No. 314	2	0	0	5	0	0
No. 181	Not examined			7	0	0
No. 428	Not examined			2	0	0
No. 907	Not examined			7	0	0

* Blood sugar 461 mg. per cent.
† Blood sugar 353 mg. per cent.

Fig. 5. The gastro-intestinal tract of different dogs, illustrating characteristic appearance in the normal and depancreatized animal. Figures are so arranged that the preoperative examination (normal blood sugar) is between the post-pancreatectomy examinations. The one above is during hypoglycemia, the one below during hyperglycemia. S. Stomach. I. Small intestine. L. Large bowel.

A. Dog No. 428 following pancreatectomy. Blood sugar 43 mg. per cent.

B. Dog No. 892 before pancreatectomy. Blood sugar normal.

C. Dog No. 251 following pancreatectomy. Blood sugar 321 mg. per cent. Marked delay in gastric emptying time and small-intestinal transit time. Note similarity of appearance of small intestine to that of the normal dog (5B and 6B).

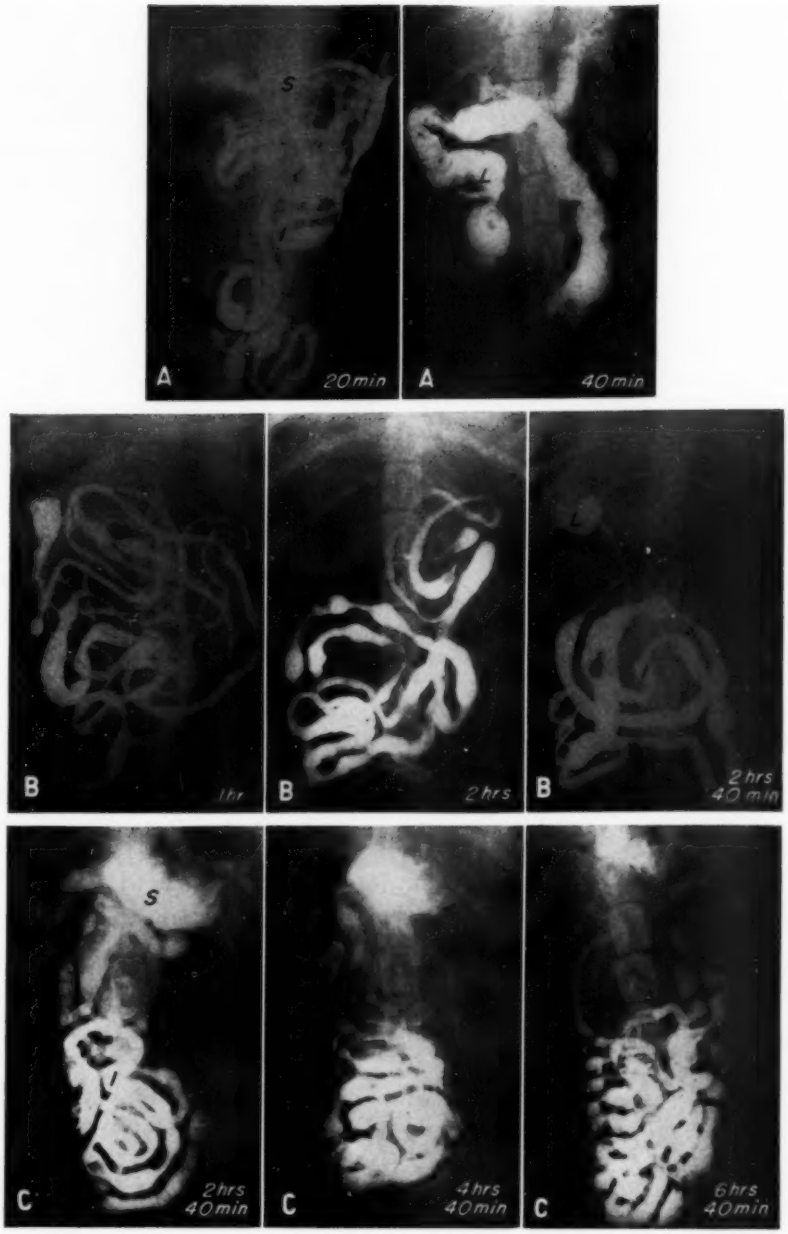

Fig. 6. Appearance of the gastro-intestinal tract of dog No. 314 before and following pancreatectomy. The figures are so arranged that the preoperative examination is between those following pancreatectomy, with the examination during hypoglycemia above and the one during hyperglycemia below. S. Stomach. I. Small intestine. L. Large bowel.

A. Following pancreatectomy, blood sugar 42 mg. per cent. Most of the barium meal is in the large bowel in forty minutes.

B. Before pancreatectomy.

C. Following pancreatectomy; blood sugar 259 mg. per cent. Marked delay of gastric emptying and small-intestinal transit.

the column as an indication of integrated function of the small intestine within itself. Since, in general, the gastro-intestinal tract as a unit responds without specificity, it follows that individual categories do likewise.

In this study the categories in which changes occurred were limited to gastric emptying and small-intestinal transit times. Gastro-intestinal motility has been shown to be prolonged by a number of conditions, including hypoproteinemia (2, 3, 12), vitamin B complex deficiency (7), diabetes insipidus (15), exclusion of bile from the gastro-intestinal tract (9, 17), and emotional disturbance. Hyperglycemia has also been found to delay gastro-intestinal motility (6, 18). In the present study of depancreatized dogs, delayed motility of the stomach and small intestine was invariably observed during periods of hyperglycemia but not during hypoglycemia. No significant changes were observed when the blood sugar was low.

The marked delay in gastric emptying during hyperglycemia, with occasional obvious gastric distention, is of interest, as it raises the question of whether the administration of glucose solutions postoperatively might contribute to postoperative gastric retention and nausea in man. The usual rate of administration of one liter of 5 per cent glucose has been shown consistently to produce glycosuria (11).

The primary purpose of this study was to gain further knowledge of the response of the gastro-intestinal tract to alterations of pancreatic function. It was hoped that, if discoveries were made of alterations of response in the dog, they might also be applicable to man. Although it is recognized that it is difficult to transfer results of animal experiments to clinical medicine, it is fortunate that a comparison study in man has been made. Brackin investigated the gastro-intestinal tract in patients with diabetes mellitus (4). Roentgen examinations were performed while the diabetes was controlled and compared with examinations of the same patient when the blood sugar was elevated. The frequent finding of delayed gastric emptying and delayed small-intestinal transit during hyperglycemia in the diabetic patients indicates a correlation between clinical observations and the results of this study.

As frequently occurs in investigations involving biological processes, significant variations occurred, the causes of which cannot be readily explained. These include: change in gastric motility and in continuity of the small-intestinal pattern of one control dog (No. 578) on the special diet, prolonged small-intestinal transit time in one depancreatized dog (No. 907) regardless of the blood sugar level, and loss of gastric tone associated with hyperglycemia in one depancreatized dog (No. 181).

Because delayed gastric motility was evident in some examinations of one control dog following the change of diet, the question arose as to whether motility was influenced by the type of diet throughout the experiment. In view of the consistency with which delayed motility occurred with hyperglycemia, however, diet could not have played a predominant role.

It is evident from this study that, if the effects of loss of the external secretion of the pancreas upon the gastro-intestinal tract are to be evaluated, they must be studied while the blood sugar concentration is within normal limits. In order to obtain such additional data, it is planned to repeat the roentgen observations before and after ligation of the pancreatic ducts.

CONCLUSIONS

1. Hyperglycemia in depancreatized dogs was found to be associated with delayed gastric emptying and with prolonged small-intestinal transit time.

2. Hypoglycemia in depancreatized dogs was associated with a normal and, at times, rapid gastric emptying and small-intestinal transit time.

3. The absence of external secretion

of the pancreas from the intestine did not appear to alter the tone or continuity of the small intestinal pattern or the tone of the proximal colon.

4. Loss of pancreatic function was not shown to alter gastro-intestinal motility while the blood sugar was low; its effects could not be evaluated while the blood sugar was elevated.

NOTE: Sincere appreciation is expressed to Dr. S. M. Fox, III, for the medical management of the depancreatized animals, to Mrs. J. C. Brown for the laboratory determinations, and to Dr. E. D. Burdick for his assistance in analysis of the data. Grateful acknowledgment is made to Sharp and Dohme for funds generously contributed.

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SUMARIO

Estudio Roentgenológico del Efecto de la Pancreatectomía Total sobre el Estómago y el Intestino Delgado del Perro

Estos experimentos en perros tenían por objeto determinar los efectos de la exclusión de las secreciones internas y externas del páncreas sobre el tubo gastrointestinal. Seis perros fueron sometidos a una pancreatectomía total, y el efecto del tenor glucémico sobre el tiempo del vaciamiento, la tonicidad y la movilidad del estómago y sobre el tiempo del paso, la tonicidad y el mantenimiento del patrón en el intestino delgado fué estudiado postoperatoriamente durante períodos de hiper- y de hipoglucemia (a las dos horas de la administración de insulina).

La hiperglucemia en los animales despancreatizados estuvo, según se observó, asociada con demora en el vaciamiento gástrico y prolongación del tiempo de paso por el intestino delgado. Con la hipoglucemia hubo vaciamiento gástrico y paso por el intestino delgado normales, o a veces, rápidos.

La ausencia de la secreción externa del páncreas, del intestino, no alteró aparentemente la tonicidad o continuidad del patrón del intestino delgado ni la tonicidad del colon proximal.

No se observó que la pérdida de la función pancreática alterase la movilidad gastrointestinal en presencia de hipoglucemia; no pudieron determinarse los efectos mientras había hiperglucemia.

Effect of Radiation Dosage on the Results in Carcinoma of the Cervix[1]

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IT IS WELL RECOGNIZED that gradual improvement over the years in the apparatus and technic of radiation therapy has resulted in more effective treatment of cancer. In the series of cases of carcinoma of the cervix here presented, a change in equipment provided a dividing line for a demonstration of the influence of the factor of radiation dosage. The series is also of some interest as presenting the results from a small general hospital.

MATERIAL

The material analyzed in this paper includes the cases of carcinoma of the cervix seen at the Mary Hitchcock Memorial Hospital (Hanover, N. H.) from Jan. 1, 1930, to Dec. 31, 1944. An attempt was made to follow all cases of primary (previously untreated) disease. This group comprised 113 cases, which are analyzed in conformity to the League of Nations requirements, both in respect to classification and in interpretation of results. Follow-up was done by examination at the Hitchcock Clinic, through the family physician or, in a few cases, by correspondence with the patient.

The average age of the patients studied was fifty years, with the youngest twenty-seven and the oldest eighty-one. Abnormal vaginal bleeding was the presenting symptom in all but 6 cases. Classification as to gross appearance of the lesion was found to be impossible because of the variety of description, or lack of description, afforded by the many different examiners. Cases were grouped as to stage according to the League of Nations classification. The microscopic grading is shown in Table I. This grading was done at different periods by different pathologists, with some variation of criteria.

TABLE I: CARCINOMA OF THE CERVIX: HISTOLOGIC GRADING

Microscopic Classification	Ellis Fischel State Cancer Hospital, 453 Cases	Mary Hitchcock Memorial Hospital, 113 Cases
Adenocarcinoma	3.7%	4%
Epidermoid carcinoma	94.5%	96%
In situ	0.5%	0.8%
Grade 1	3.5%	3%
Grade 2	82.2%	49%
Grade 3	10.7%	26%
Grade 4	...	5%
Ungraded	3.0%	12%

Of the 113 patients in this series, all except 2 have been traced. These 2 are considered dead of disease and all deaths from intercurrent diseases are also considered as deaths from cancer.

All patients were treated with radiation with the exception of 2, who had panhysterectomies. Of these 2 patients, 1 is alive twenty years after operation and the other is untraced and presumed to be dead.

RESULTS

The series was analyzed as a whole and also divided into two groups according to the radiation technic employed. The change in method of treatment, as detailed below, occurred early in 1940, and this dividing line was used to separate the two groups: Group I, comprising those cases treated between Jan. 1, 1930, and Dec. 31, 1939; Group II, those treated between Jan. 1, 1940, and Dec. 31, 1944.

The over-all five-year survival rate, 34 per cent for the entire series, is comparable to the average of other reported results

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TABLE II: COMPARISON OF FIVE-YEAR SURVIVAL RATES (ABSOLUTE) IN VARIOUS SERIES OF CARCINOMA OF THE CERVIX REPORTED IN THE LAST TWENTY YEARS

Source	Total Cases	Technic	Five-Year Survival
Taylor and Twombly	920	Massive dose	28.5%
		Divided dose	35.4%
Pitts and Waterman	264	Interstitial radium	36.0%
University of Paris	...	Regaud	47.2%
Pomeroy	790	...	24.9%
Heyman	4,000	Stockholm	35.0%
Memorial Hospital (N. Y.)	1,037	...	27.6%
Schmitz	...	Supervoltage	37.5%
League of Nations Survey	5,669	All	26.0%
Mary Hitchcock Memorial Hospital	113	Stockholm	34.0%

(Table II). A striking difference in salvage was shown, however, between Group I and Group II, the percentage of five-year survivals in the latter being double the rate in the former (Fig. 1). In spite of the small number of cases involved, this difference is sufficiently great to be statistically significant. A study of each group as to staging and age incidence (Table III) indicates that the two series are comparable. The incidence of fistula formation in the two groups is evidence of the increase in tissue dosage in the second series. In Group I, no vesicovaginal or rectovesical fistulae were encountered, whereas in Group II the incidence was 7 per cent, comparable to other reported results (Table IV). The improvement in survival rate in Group II as compared to Group I may therefore be attributed to the improvement in radiation dosage. Survival curves according to stage of disease reveal the expected variation in results in relation to the extent of involvement at the time of initial treatment (Figs. 2 and 3).

In the first period, from 1930 to 1940, treatment consisted of one radium application and one roentgen series, the radium application at times preceding and at times following the roentgen series, with an interval of three to four weeks. The usual radium application consisted of a dose of 3,000 mg.-hours with the radium

TABLE III: CLINICAL STAGING AND AGE RANGE OF 113 CASES OF CARCINOMA OF THE CERVIX

	1930–1940	1940–1945
Clinical Stage		
Stage 1	45%	41%
Stage 2	22%	28%
Stage 3	15%	13%
Stage 4	15%	13%
Unclassified	3%	5%
Age range	27–81 years	32–79 years
Average age	48.7 years	52.2 years

TABLE IV: INCIDENCE OF FISTULAE FOLLOWING TREATMENT OF CARCINOMA OF THE CERVIX

Mary Hitchcock Memorial Hospital	
Group I: 1930–1940	0.0%
Group II: 1940–1945	7.0%
Meigs	
Radiation therapy (24 cases)	8.0%
Surgery without radiation (41 cases)	14.6%
Pitts and Waterman	
Interstitial radium	7.9%
Taylor and Twombly	
Interstitial radium	12.0%
Transvaginal cone	5.0%

in a cross-arm applicator, 50 mg. in the stem and 50 mg. in the cross-arm. Filtration was 0.5 mm. platinum plus 2.0 mm. brass.

The roentgen series consisted of 1,000 to 1,500 r, measured in air, to each of two 20 × 20-cm. ports, one over the anterior pelvis and one over the posterior pelvis, treatments being given daily in a dosage of 250 r to one field. The radiation was delivered by a mechanically rectified apparatus operating at 200 kv.p. with filtration of 0.5 mm. of copper and 1.0 mm. of aluminum and a target-skin distance of 50 cm., with the tube located beneath the treatment couch.

In early 1940 a valve-tube shock-proof deep therapy apparatus was installed, and the treatment program was materially modified. This machine was operated at 200 kv.p. with filtration of 0.5 mm. of copper and 1.0 mm. of aluminum and target-skin distance of 50 cm., the half-value layer being 0.9 mm. of copper. Treatment was given through four pelvic ports, two anterior and two posterior, each measuring 10 × 15 cm. One port was treated daily with a dose of 300 r, measured in air, in the usual case, to a total of 1,800 r to 2,400 r per port, depending on the skin reaction.

Two radium applications were given in conjunction with the roentgen series, usually following it at three-week intervals. One was given with a cross-arm applicator, with 100 mg. of radium distributed in the cross-arm and one or two segments of the stem, depending on the size of the uterus. The usual dose for this application was 3,500 mg.-hours. The other application was made with a colpostat, with one capsule in each lateral fornix, each capsule containing 50 mg. of radium. The usual dose for this application was 3,000 mg.-hours. Filtration with the cross-arm applicator was 0.5 mm. platinum, plus 2.0 mm. brass; with the colpostat applicator, 0.5 mm. platinum plus 2.0 mm. lead.

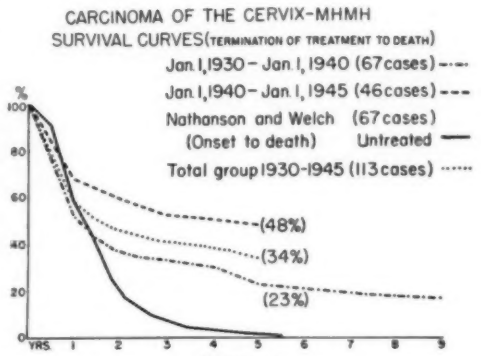

Figure 1

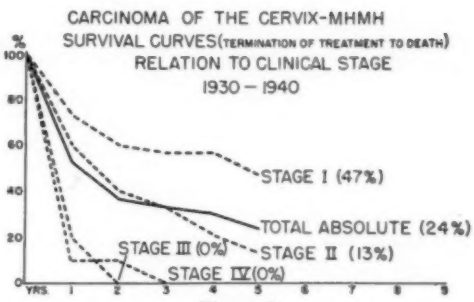

Figure 2

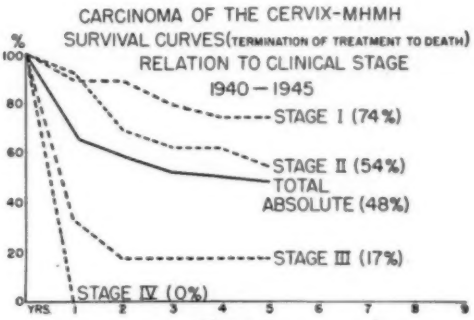

Figure 3

TABLE V. CALCULATED TUMOR DOSE IN 113 CASES OF CARCINOMA OF THE CERVIX

	1930–1940	1940–1945
Point A		
Gamma roentgens	2,075	4,561
Roentgens	1,350	2,000
Total	3,425	6,461
Point B		
Gamma roentgens	420	1,008
Roentgens	1,350	2,000
Total	1,770	3,008

Comparison of the calculated tissue doses for the two groups, combining roentgens and gamma-roentgens, is given in Table V. Gamma-roentgens were calculated according to Quimby's table for linear sources.

SUMMARY

A series of 113 cases of carcinoma of the cervix is analyzed. Of these, all except 2 were treated by radiation. Five-year survival rates by two different methods of radiation treatment are compared. The absolute five-year survival rate for the entire group was 34 per cent. Improvement in technic and larger dosage resulted in an increase in the survival rate from 23 per cent to 48 per cent.

Mary Hitchcock Memorial Hospital
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SUMARIO

Efecto de la Dosis de Irradiación sobre los Resultados Obtenidos en el Carcinoma del Cuello Uterino

En la serie analizada, de 113 casos de carcinoma del cuello uterino, todos menos 2 fueron tratados con la irradiación. Compáranse los coeficientes de sobrevivencia de cinco años obtenidos con dos distintos métodos de radioterapia. La tasa absoluta de sobrevivencia de cinco años para todo el grupo representó 34 por ciento. El perfeccionamiento de la técnica y el aumento de la dosis lograron un aumento de la tasa de 23 por ciento a 48 por ciento.

El período de tiempo abarcado por el estudio comprendió del 1° de eno. de 1930 al 31 de dbre. de 1944. Del 1° de eno. de 1930 al 31 de dbre. de 1939, el tratamiento consistió en una aplicación de radio y una serie de rayos X, siendo la dosis habitual de radio de 3,000 mg. horas y la total de rayos X de 1,000 a 1,500 r (al aire) a cada una de dos puertas (250 r a un campo diariamente). El coeficiente de sobrevivencia quinquenal para ese período de tiempo fué de 23 por ciento. La instalación de nuevos aparatos en 1940 permitió acrecentar la dosis roentgenológica, y del 1° de eno. de 1940 al 31 de dbre. de 1944, se administró tratamiento por cuatro puertas (300 r al aire a una puerta diariamente) hasta un total de 1,800 a 2,400 r por puerta. Dos aplicaciones de radio, representando 3,500 mg. horas y 3,000 mg. horas, respectivamente, completaron el tratamiento. El coeficiente de sobrevivencia quinquenal para los casos así tratados fué de 48 por ciento.

Intravenous Pyelography as an Aid in Classification of Carcinoma of the Cervix[1]

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THE FACTORS which determine the ultimate outcome in carcinoma of the cervix are multiple. The radiosensitivity of the tumor and the clinical stage of the disease at which adequate treatment is instituted are, however, the most important guides to prognosis.

There is considerable disagreement as to the correlation of pathological groupings and successful results. Actually, it has been our impression, and that of many others, that in carcinoma of the cervix, the extent and duration of the disease are of greater significance in determining the prognosis than the microscopic evidence of the degree of malignancy. We feel that the amount of success obtained in treatment depends largely on the extent of the disease. A clinical classification before radiation therapy is instituted is therefore of the utmost importance.

Since 1938, the classification of carcinoma of the cervix as outlined by the Cancer Committee of the League of Nations has been adhered to closely in the Radiation Therapy Department at Bellevue Hospital (New York). A careful history is obtained and abdominal, vaginal, and rectal examinations, including biopsy, are done in every case. Further special studies of the urinary system are carried out in all cases by means of intravenous pyelography. When indicated, this is supplemented by cystoscopy and retrograde pyelography. Determination of the stage of the disease depends on the results of the above studies. We have found that examination of the urinary tract is of vital importance in this connection. In fact, over the years, we have come to the conclusion that a pathological condition of the bladder, ureter, or kidneys, secondary to the primary disease, is of greater importance in determination of the stage than the findings on inspection or palpation.

Carcinoma of the cervix begins usually on the cervical lip, but in some instances in the endocervical canal. It spreads by direct extension into the upper cervical tissues, to the broad ligaments and the regional lymph nodes. Occasionally, because of the close proximity of the ureters, they may be compressed by one of the lymph nodes or directly invaded. The kidneys are involved secondarily due to blocking of the ureters and subsequent infection. Primarily the disease remains medial to the ureters. Later, as the cancer advances, more extensive involvement takes place, with blocking of one or both ureters. This again leads to interference with kidney function and urinary infection. Then, too, there is occasional involvement of the bladder. This may be by direct invasion through the vagina or through the pelvis. Fistulae may follow from malignant destruction of the vesicovaginal wall.

Pomeroy (1, 9), who advocates routine pre-treatment cystoscopy and pyelography, found abnormalities such as hydronephrosis or functionless kidney in 16.2 per cent of 27 patients with cervical carcinoma, as compared to an incidence of 2 per cent in the normal population. Herger and Schreiner (2) in a study of 82 cases coming to autopsy observed gross disease of the urinary apparatus in 66 per cent. Graves and Kickham (3, 8,) found evidence of obstruction in 70.7 per cent of 174 cases

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Fig. 1. Case I. Stage II with non-functioning kidney = Stage IV

in Stages III and IV. Valk (4) reported abnormal findings in 64 per cent of Stage IV cases. Drexler and Howes (6) listed 19 per cent of 50 patients as having non-functioning kidney, advanced hydronephrosis and hydroureter, or pyonephrosis. Leucutia (5) stated that ureteral obstruction occurs so frequently that it must be considered a natural sequence in later stages. Once a hydronephrosis is established, gradual destruction of the kidney can be delayed but not prevented. Although the possibility of post-irradiation fibrosis contributing to urinary obstruction was considered, Schmitz (7) indicated that almost every case of ureteral obstruction was due to active cellular proliferation.

We all know that carcinoma of the cervix is rarely the immediate cause of death *per se*. The natural termination in most cases is through uremia from occlusion of the ureters. In about 40 per cent of cases death is due to invasion or obstruction of the urinary tract. Kidney function tests are especially important in the presence of unilateral or bilateral parametrial involvement to determine the extent of invasion, ureteral blocking, or kidney dysfunction, in order to care properly for such complications before and

Fig. 2. Case II. Stage II with hydronephrosis = Stage IV

during the period when radiation is administered. In many patients, occlusion of a ureter has produced few or no symptoms. A five-year cure in such cases is rarely to be expected. Discovery of interference with the upper urinary tract before treatment is started is therefore of great prognostic significance. Such cases can then be automatically classified as of a more advanced stage, regardless of the extent of cervical involvement as noted by inspection and palpation. Early invasion of the bladder may be determined by cystoscopy in addition to urography, and this finding too should lead to a transfer from a clinically earlier stage to a more advanced one.

In the period from 1937 to 1946 there

were seen in the Radiation Therapy Department of Bellevue Hospital 638 cases of cervical carcinoma. Of these, 371 were classed as Stage IV carcinoma. Forty per cent of this number (148 cases) were clinically classed as Stage II or III but

Fig. 3. Case III. Stage III with non-functioning kidney = Stage IV

had to be transferred to the Stage IV group following urinary tract investigation. The subsequent histories of these patients bear out our contention that they were in an advanced stage of the disease in spite of the apparent paucity of findings in the cervical region.

Four illustrative cases follow.

CASE I: A. F., age 43, was referred to us on Jan. 14, 1949, complaining of vaginal bleeding of eight months duration and backaches for the past seven weeks. A diagnosis of squamous-cell carcinoma of the cervix with slight parametrial extension had been made at another institution. Fibromyoma of the uterus was also present. On intravenous pyelography the kidney on the left side was not visualized. The right urinary tract was essentially normal. Cystoscopic examination revealed no visible invasion of the bladder or urethral mucosa,

Fig. 4. Case IV. Stage III with non-functioning kidney = Stage IV

though the floor of the bladder was elevated and reddened. Because of these findings, the diagnosis was changed from Stage II+ or III to Stage IV.

CASE II: P. E. J., age 66, was admitted Dec. 23, 1948, complaining of vaginal bleeding of four months duration. Examination on admission disclosed cervical carcinoma with induration in both parametria, especially on the right. Intravenous pyelography revealed a moderate left hydronephrosis. Because of the invasion of the urinary tract, the case was classified as Stage IV.

CASE III: G. M., age 41, was admitted to our service May 23, 1949, complaining of vaginal bleeding for a year. The cervix was hard and irregular, with induration extending from the vaginal wall into both parametria. Intravenous pyelography revealed an enlarged right kidney, with moderate dilatation of the renal pelvis, and a non-functioning left kidney. While clinically, this case had been considered as Stage III or III+, due to invasion of the urinary tract it was now placed in Stage IV.

CASE IV: B. V., age 30, was admitted Dec. 6, 1948, complaining of vaginal bleeding for three months and irregular periods of seven months duration. Examination revealed a large cauliflower mass replacing the cervix, with induration extending to both parametria, more especially on the

right. The intravenous pyelogram revealed marked hydronephrotic changes in the right pelvis, with clubbing of the major calyces. There was considerable dilatation of the ureter. There was no evidence of contrast medium on the left. Retrograde pyelography revealed obstruction of both ureters and compression of the trigonal area by an extrinsic tumor. While clinically this case had been classified as Stage III, because of the results of urinary investigation it was placed in Stage IV.

In summary, we feel that all cases of carcinoma of the cervix should have routinely a careful urinary tract investigation by intravenous pyelography, supplemented, if necessary, by cystoscopy and retrograde pyelography. Regardless of the clinical stage of the disease, definite involvement of the urinary tract, as bladder invasion, ureteral blocking with hydronephrosis, or non-functioning kidney, is of grave prognostic significance. Such cases must be classified as Stage IV and treatment must be of the type that this advanced stage entails.

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SUMARIO

La Pielografía Endovenosa como Auxiliar en la Clasifícación del Carcinoma del Cuello Uterino

En el Departamento de Radioterapia del Hospital Bellevue (de la ciudad de Nueva York) verifican estudios especiales del aparato urinario en todos los casos de carcinoma del cuello uterino por medio de la pielografía intravenosa, complementada, cuando está esto indicado, con la cistoscopia y la pielografía retrógrada.

Independientemente de la etapa clínica de la dolencia, toda extensión bien definida al aparato urinario, en forma de invasión vesical, oclusión ureteral con hidronefrosis o falta de función renal, reviste gravedad para el pronóstico. Esos casos deben ser clasificados como pertenecientes al Período IV y el tratamiento tomará la forma que exige dicho período avanzado de la enfermedad.

EDITORIAL

Activities of the American College of Radiology

At the Meeting of the Southern Medical Association in 1951, Dr. John S. Bouslog presented a résumé of the activities of the American College of Radiology. Dr. Bouslog has kindly given RADIOLOGY permission to use this material editorially and we present it here in somewhat abbreviated form.

* * * * *

What are the functions of the American College of Radiology? Some idea of the history of the organization may help to give an answer to this question.

The idea of creating a national organization in the United States to promote high ideals in the practice of radiology and to recognize achievement in the profession originated in the mind of the late Dr. Albert Soiland, of Los Angeles, in 1922. The first assembly and convocation of the College was held in Chicago on June 11, 1924, and in that year a charter was received from the State of California, whereby the College became a regularly incorporated not-for-profit association. Its object, as stated in the Constitution and Bylaws adopted at the organization meeting, was "to create a fellowship among medical men who have distinguished themselves in the science of Radiology."

Conceived as an honorary society, the College originally limited its Fellowship to one hundred (100), but in 1930 the Bylaws were amended to provide for the election of not more than five new Fellows each year.

By 1935, the entire medical profession in the United States was becoming acutely aware of powerful social and economic forces affecting the practice of medicine, and at the annual conferences of the College there was considerable discussion concerning these matters as they affected the practice of radiology. Already the College had extended the scope of its functions and was no longer merely an honorary society. It had proposed and accomplished the organization of a Section on Radiology in the Scientific Assembly of the American Medical Association. Later it instigated a movement that culminated in the creation of the American Board of Radiology for the certification of specialists in this field. It had created a Commission on Medical Economics, with Dr. A. C. Christie, of Washington, D. C., as chairman, for the purpose of studying and making recommendations concerning the economic aspects of radiology.

A Commission on Education had been appointed to evaluate facilities and establish standards for graduate training in radiology, and in 1936, under the direction of this Commission, the first Conference of Teachers of Clinical Radiology was held for the purpose of discussing teaching problems and educational standards.

In 1937, the Board of Chancellors of the College suggested to the American Roentgen Ray Society, the Radiological Society of North America, and the American Radium Society, the creation of an Inter-Society Committee for Radiology to be supported by the funds of all four societies. This suggestion was adopted, an executive secretary was employed, and an ambitious and effective program was set in motion.

In 1939 the Inter-Society Committee, feeling that its functions could best be performed through a single organization, suggested that the College assume this role. The sponsoring societies agreed. Since the organic law of the College was not suitable to its enlarged functions, a

new Constitution was adopted, in which the objects of the organization were clearly stated:

"To establish an organization of radiologists for the purpose of advancing the science of radiology and improving radiologic service to the sick by means of the study of the economic aspects of the practice of radiology, and encouragement of improved educational facilities for radiologists."

The membership of the College was opened to all ethical Diplomates of the American Board of Radiology, two classes of membership being recognized by the new Constitution, Members and Fellows.

Thus, through a logical sequence of events, the American College of Radiology has evolved from a small honorary society in 1923 to a large and active organization, representing all organized radiology, with a full time headquarters staff in Chicago and thirty-three commissions and committees, in the work of which well over one hundred (100) Members and Fellows actively participate.

The Board of Chancellors is the executive and governing body of the College. By virtue of its broad representation (four of the twelve Chancellors are nominated respectively by the Radiological Society of North America, American Roentgen Ray Society, American Radium Society, and Canadian Association of Radiologists), it represents the official voice of organized radiology on socio-economic problems. It is the authority which endorses, amends, or rejects reports or recommendations of all commissions and committees and directs the course of the College.

The Commission on Hospital Standards is concerned with improving standards for hospitals and radiologists. The Blue Cross comprehensive plan is of concern to this Commission at the present time.

The Commission on Education is responsible for all the activities of the College contemplated in the constitutional provisions which make radiological education one of its primary functions. This Commission attempts to correlate and to fill the gaps left in the educational field by the American Roentgen Ray Society, the Radiological Society of North America, and the American Radium Society, but not to supplant these societies. It has in the past presented intensive postgraduate courses in conjunction with local radiological societies. As mentioned earlier, it sponsors the Annual Conferences of Teachers of Clinical Radiology which affords an opportunity for teachers of radiology to discuss mutual pedagogical problems. It has now in course of preparation a manual of graduate training in radiology, and a list of recommended radiological reading for residents.

In 1951 the Commission on Education in a co-operative effort with the Commission on Radiological Units, Standards, and Protection, supervised the distribution of material relating to the radiologic aspects of defense against atomic weapons. Participation in the support of a fellowship at the Registry of Radiologic Pathology at the Armed Forces Institute of Pathology in Washington, D. C., also comes under this Commission.

There was a time when radiologists paid little attention to public relations, but they are again on the firing line. For many years the College has had a Commission on Public Relations which conducts a program to improve the public understanding of the medical profession and of the medical specialty of radiology, particularly. The Commission has, upon request, assumed responsibility for press relations during the annual scientific sessions of the national radiological societies, and prepares monthly news releases from RADIOLOGY and the *American Journal of Roentgenology*.

Under this Commission is the Committee on Radiology in Rural Health, concerned with the problem of bringing good radiological services to rural areas, and the Committee on X-Ray Department Planning. This last named Committee is preparing a manual on department planning, which should prove valuable to radiologists, hospital architects, and hospital personnel.

The Commission on Credentials investigates the qualifications of applicants for membership in the American College of Radiology. All Diplomates of the American Board and of the Royal College of Canada are automatically nominated for membership by the Executive Secretary pursuant to the Bylaws. Candidates are investigated by correspondence and personal interview by the Commission, and recommendations concerning each candidate are submitted to the Board of Chancellors. Election to Fellowship rests with the Fellows and is based upon contributions to the advancement of the science and practice of radiology. Nomination for Fellowship must come from a Fellow in the same community as the candidate.

The Commission on Public Health includes Committees on Cancer and Diseases of the Chest. Under the supervision of this Commission, principles governing chest surveys and routine chest examinations on all hospitalizations have been promulgated and published by the College. The Committee on Cancer is engaged in a co-operative effort with the American College of Surgeons, the American Cancer Society, and the College of American Pathologists, to standardize the reporting of cancer end results.

Under this Commission, there has been established a Joint Committee on Diseases of the Chest with the American College of Chest Physicians. The Joint Committee has found many areas of agreement between the two organizations and has issued a report which has been widely reprinted.

The Advisory Committee to the American Society of X-Ray Technicians acts as a liaison committee and not only advises the American Society of X-Ray Technicians, but keeps the Board of Chancellors informed by periodic reports on the activities of the technicians' organization. With the invaluable assistance of the Councilors of the College, the Advisory Committee is currently engaged in an analysis of the adequacy of courses in schools of x-ray technic, undertaken at the request of the Council on Medical Education and Hospitals of the American Medical Association.

The duties of the Commission on Radiological Units, Standards, and Protection are well indicated by its title. Under this Commission there has recently been organized a Committee on Drugs and New Devices, at the request of the Federal Food and Drug Administration. It is anticipated that this committee will pass and make recommendations in regard to drugs and new devices involved in the practice of radiology.

The Commission on Legislation and Public Health is concerned with legislation pertaining to or affecting radiology introduced in the legislatures of the forty-eight states and the Federal Congress. It is also concerned with the activities of other agencies and organizations of a public nature whose interests touch upon those of the College. Among present interests of the Commission are the possibility of enactment of federalized compulsory health insurance, the extension of Blue Shield on a national basis, and the implications of the demand which is being voiced nationally, from within and without medicine, for the provision of increased government-sponsored diagnostic clinics.

The funds of the College are technically under the charge of the Commission on Finance, which submits an annual budget for the approval of the Board of Chancellors, and determines investment policy, employee security, and all activities involving the financial life of the College. Day-to-day expenditures are under the supervision of the Treasurer.

The Commission on the Constitution and Bylaws receives suggestions for amendment of the organic law of the College, and serves as a drafting board for this legislation.

The Professional Bureau, under the guidance of Dr. Sam W. Donaldson, serves as an advisory agency to radiologists seeking locations, and attempts to assist them to work out proper fiscal arrangements with hospitals and clinics. The

Bureau maintains a registry of radiologists seeking opportunities for practice, and keeps a file of requests from radiologists, hospitals, and clinics seeking radiologists.

To promote amity between our own and other countries, the Committee on International Affairs helps plan participation by radiologists of the United States in Interamerican and International Congresses. A number of prominent radiologists in other countries are Honorary Fellows of the College.

In addition to the administrative structure outlined above, special committees are appointed from time to time to handle matters of transitory nature.

Upon the nomination of state and regional radiologic societies, the Board of Chancellors appoints Councilors, who keep the College informed as to local happenings of radiologic interest and apprise local radiological societies of information emanating from College headquarters. Councilors serve both as advisors to the College and to radiologists practising within their localities. They unquestionably perform some of the most valuable work within the College organization.

I have tried briefly to outline the American College of Radiology, and to answer the opening question as to its functions. How well it serves each individual member and the specialty of radiology depends upon the members themselves in bringing their problems to the College for help in their solution. JOHN S. BOUSLOG, M.D.

ANNOUNCEMENTS AND BOOK REVIEWS

ARIZONA RADIOLOGICAL SOCIETY

At the Annual Meeting of the Arizona Radiological Society, held on May 4, 1952, the following officers were elected: President, Herbert D. Welsh, M.D., Tucson; Vice-President, Edward H. Bregman, M.D., Phoenix; Secretary-Treasurer, R. Lee Foster, M.D., 15 E. Monroe, Phoenix.

SECTION ON RADIOLOGY CALIFORNIA MEDICAL ASSOCIATION

The following officers have been elected for the ensuing year by the Section on Radiology of the California Medical Association: Chairman of Section, Robert K. Arbuckle, M.D., Oakland; Secretary, Calvin L. Stewart, M.D., 2330 First Ave., San Diego 1; Assistant Secretary, H. R. Morris, M.D., Redlands Community Hospital, Redlands.

PACIFIC ROENTGEN SOCIETY

At the Annual Meeting of the Pacific Roentgen Society, held during the Annual Convention of the California Medical Association, Dr. A. K. Merchant, Stockton, was elected Chairman; Dr. Roy W. Johnson, Los Angeles, member of the Executive Committee; Dr. L. Henry Garland, 450 Sutter St., San Francisco 8, Secretary-Treasurer. The Society now numbers 275 members.

ATLANTA RADIOLOGICAL SOCIETY

The recently elected officers of the Atlanta (Georgia) Radiological Society are: Simon Krantz, M.D., President; Wm. C. Coles, M.D., Vice-President; Albert A. Rayle, Jr., M.D., 748 Peachtree St., N.E., Atlanta, Secretary-Treasurer.

GEORGIA RADIOLOGICAL SOCIETY

At a recent meeting of the Georgia Radiological Society, held in conjunction with the State Medical Association, the following officers were chosen for the ensuing year: Dr. George M. Hutto, Columbus, President; Dr. Albert A. Rayle, Jr., Atlanta, Vice-President; Dr. Robert M. Tankesley, 218 Doctors Bldg., Atlanta, Secretary-Treasurer. Dr. Barton R. Young, of Philadelphia, was guest speaker at the meeting.

CHICAGO ROENTGEN SOCIETY

The newly elected officers of the Chicago Roentgen Society are: Benjamin D. Braun, M.D., President; Roger A. Harvey, M.D., Vice-President; Elbert K. Lewis, M.D., 6337 S. Harvard Ave., Chicago 21, Secretary-Treasurer.

INDIANA ROENTGEN SOCIETY

The 24th Annual Meeting of the Indiana Roentgen Society was held on Sunday, May 4, with Dr. Fred J. Hodges of Ann Arbor, Mich., as the guest speaker. The following officers were elected: President, M. J. Thornton, M.D., South Bend; Vice-President, C. E. Skomp, M.D., Marion; Secretary-Treasurer, John A. Robb, M.D., 23 E. Ohio St., Indianapolis.

NEW ENGLAND ROENTGEN RAY SOCIETY

At the Annual Meeting of the New England Roentgen Ray Society, held at the Hotel Somerset, Boston, May 16, the following officers were elected for 1952–53: President, Dr. Douglas J. Roberts, Hartford, Conn.; Vice-President, Dr. Wm. S. Altman, Quincy, Mass.; Secretary, Dr. Stanley M. Wyman, Massachusetts General Hospital, Boston 14; Treasurer, Dr. Magnus I. Smedal, Boston.

RADIOLOGICAL SOCIETY OF GREATER CINCINNATI

At a recent meeting of the Radiological Society of Greater Cincinnati the following officers were elected for 1952–53: President, Dr. Lee Rosenberg; Vice-President, Dr. Nathan Flax; Secretary-Treasurer, Dr. Harry K. Hines, 2508 Auburn Ave., Cincinnati 19.

OKLAHOMA STATE RADIOLOGICAL SOCIETY

At its meeting on May 2, the Oklahoma State Radiological Society elected the following officers for a two-year term: President, Dr. Walter E. Brown, Tulsa; Vice-President, Dr. Edward D. Greenberger, McAlester; Secretary-Treasurer, Dr. John R. Danstrom, Medical Arts Bldg., Oklahoma City. In May the Society joined with the University of Oklahoma in sponsoring a two-day Postgraduate Course in X-Ray Diagnosis for the general practitioners of the state.

PHILADELPHIA ROENTGEN RAY SOCIETY

The newly elected officers of the Philadelphia Roentgen Ray Society are: President, Theodore P. Eberhard, M.D.; Vice-President, Richard H. Chamberlain, M.D.; Secretary, George P. Keefer, M.D., American Oncologic Hospital; Treasurer, D. Alan Sampson, M.D.; Councilor-at-Large, Herbert M. Stauffer, M.D.

TENNESSEE RADIOLOGICAL SOCIETY

At the recent Annual Meeting of the Tennessee Radiological Society Dr. J. E. Whiteleather, Mem-

phis, was elected President; Dr. Joseph McKinney Ivie, Nashville, Vice-President; Dr. J. Marsh Frère, Newell Hospital, Chattanooga 2, Secretary-Treasurer.

SAN ANTONIO-MILITARY RADIOLOGICAL SOCIETY

The San Antonio-Military Radiological Society meets on the first Monday of each month at Brooks Army Medical Center Officers' Mess. Dr. Hugo F. Elmendorf, Jr., is Secretary.

UTAH STATE RADIOLOGICAL SOCIETY

The officers of the Utah State Radiological Society for the current year are: President, Dr. Q. B. Coray, Salt Lake City; Vice-President, Dr. L. P. Matthei, Ogden; Secretary-Treasurer, Dr. Angus K. Wilson, 343 S. Main St., Salt Lake City 1.

CANCER SEMINAR PENROSE CANCER HOSPITAL

The Fourth Annual Cancer Seminar under the sponsorship of the Penrose Cancer Hospital and the College of American Pathologists will be held September 6, at the Broadmoor Hotel, Colorado Springs.

This year the Seminar will be devoted to gastrointestinal lesions. The guest speakers will be Leo G. Rigler, M.D., Professor of Radiology, University of Minnesota, and Lauren V. Ackerman, M.D., Professor of Surgical Pathology, Washington University. Approximately fourteen problem cases will be discussed. Participants in the meeting will receive advance material for study and will submit their diagnostic impressions.

Those interested in attending should write to James W. McMullen, M.D., Penrose Cancer Hospital, 2200 N. Cascade Ave., Colorado Springs, Colo.

SYMPOSIUM ON FUNDAMENTAL CANCER RESEARCH

The Sixth Annual Symposium on Fundamental Cancer Research sponsored by the University of Texas, M.D. Anderson Hospital for Cancer Research was held in Houston, Texas, April 25 and 26. Meeting jointly with the South Central Region College of American Pathologists, the Texas Society of Pathologists, and the Houston Society of Pathologists, the Symposium drew an attendance of about 300 persons coming from 22 states and Mexico. The meeting was divided into three major sections: a panel on nutritional factors in cancer research, a cancer pathology and radiology conference, and a session devoted to fundamental cancer research.

The annual Bertner Lecture was given by Dr. Stanhope Bayne-Jones of New York Hospital-Cornell Medical Center, whose subject was "Aspects of Cancer Research in the United States." The Bertner Award was bestowed posthumously upon Dr. George Milton Smith in recognition of his achievements as an organizer and administrator of cancer research.

Books Received

Books received are acknowledged under this heading, and such notice may be regarded as recognition of the courtesy of the sender. Reviews will be published in the interest of our readers and as space permits.

GASTROINTESTINAL X-RAY DIAGNOSIS. By MAX RITVO, M.D., Assistant Professor of Radiology, Harvard Medical School; Instructor in Radiology, Tufts Medical School; Director, Department of Radiology, Boston City Hospital; Associate in Radiology, Beth Israel Hospital, Boston, Mass., and I. A. SHAUFFER, M.D., Instructor in Radiology, Harvard Medical School; Instructor in Radiology, Tufts Medical School; Visiting Radiologist, Boston City Hospital. Published by Lea & Febiger, Philadelphia, 1952. A volume of 838 pages, with 470 illustrations (2 in color). Price $20.00.

INJURY OF THE XIPHOID. By MICHAEL BURMAN and SAMUEL E. SINBERG. A monograph of 92 pages, with 18 figures. Published by Columbia University Press, New York, 1952. Published in Great Britain, Canada and India by Geoffrey Cumberlege, Oxford University Press, London, Toronto, and Bombay. Price $3.50.

CANCER OF THE BREAST—A REVIEW. Supplement No. 4, British Journal of Radiology. By D. W. SMITHERS, M. D., M.R.C.P., D.M.R., P. RIGBY-JONES, M. B., D.M.R., D. A. G. GALTON, M.B., B. Chir., and P. M. PAYNE, B.Sc. A monograph of 90 pages from the Royal Cancer Hospital, London. Published by the British Institute of Radiology, London, 1952. Price, paper bound, 20s; cloth bound, 22s 6d.

ANNUAL REVIEW OF NUCLEAR SCIENCE: Volume I. Prepared by the Subcommittee on Publications and Information (ALBERTO F. THOMPSON, Chairman) of the Committee on Nuclear Science of the National Research Council (L. F. CURTISS, Chairman). A volume of 646 pages, with 106 figures and 58 tables. Published by Annual Reviews, Inc., Stanford, California, 1952. Price $6.00.

EXPERIMENTAL NUCLEONICS. By ERNST BLEULER, Professor of Physics, Purdue University, and GEORGE J. GOLDSMITH, Instructor in Physics, Purdue University. A volume of 394 pages, with 129 figures. Published by Rinehart & Company, Inc. New York, 1952. Price $6.50.

PROGRESS IN BIOPHYSICS AND BIOPHYSICAL CHEMISTRY. VOLUME 2. Edited by J. A. V. BUTLER, Chester Beatty Research Institute, Royal Cancer

Hospital, London, and J. T. RANDALL, F.R.S., Wheatstone Professor of Physics in the University of London, at King's College. A volume of 324 pages, with 118 figures and 10 tables. Published in Great Britain by Pergamon Press, Ltd., in the United States by Academic Press Inc., 125 East 23rd Street, New York 10, 1951. Price $8.00.

DAS BRONCHUSCARCINOM. By DOZ. DR. G. SALZER, DOZ. DR. M. WENZL, DR. R. H. JENNY, Assistenten, and DR. A. STANGL, Leiterin, des Röntgeninstitutes der II. Chirurgischen Universitätsklinik in Wien, with a contribution by DR. O. MAYRHOFER, Anästhesist der Klinik. A volume of 144 pages of text and 100 pages of illustrations (367 figures). Springer-Verlag, Wien, 1952. Price $18.60.

L'ESTOMAC EN CASCADE. ÉTUDE RADIO-CLINIQUE. By DOCTEUR JEAN ROUSSEL, Ancien Interne des Hôpitaux, Ancien Chef de Clinique à la Faculté de Médecine de Nancy. Préface by Professeur P. Kissel, Faculté de Médecine de Nancy. A volume of 136 pages, with 59 illustrations. Published by Masson et Cie, Paris, 1952. Price 1,000 fr.

In Memoriam

WILLIAM EDWARD HOWES, M.D.
1894–1952

William Edward Howes died in Honolulu on April 3, 1952, just a few days before his 58th birthday. He had undergone a laminectomy for a disk lesion and suffered a pulmonary embolism on the day before he was to be discharged.

Dr. Howes was born in Philadelphia on April 12, 1894, the son of William Howes and Agnes Peele, a descendant of the famous painter, John T. Peele. Two aunts practised medicine in Brooklyn, and a sister, Dorothea Howes, was a dentist. When young William Howes was ten, his family moved to Michigan and in 1919 he received his medical degree from the University of Michigan. He served his internship in the Brooklyn (N.Y.) Hospital and remained in Brooklyn for most of his career. Having started practice as a dermatologist, he became interested in the roentgen treatment of the skin and was naturally deflected into the field of radiology.

The record of Dr. Howes' professional life is impressive. He was a member of all of the local and national radiological societies. He established the tumor clinic at the Caledonian Hospital and was Director of Radiology at the Peck Memorial Hospital, the Lutheran Hospital, and the Brooklyn Cancer Institute. Almost single handed he raised the reputation of this last hospital to the high position it now holds. He published nearly thirty-five scientific papers. He was a Lieutenant Commander in the Navy during the last war and became consultant on isotopes at St. Albans Naval Hospital, where he had served.

William Edward Howes, M.D.

His day was intensely busy. He often arose at 5 A.M. to have time to see all the patients for whom he felt responsible. During his service at the Cancer Institute, thousands of patients went through the hospital or clinics. With some rare accidental exceptions, he saw every one of them, and he was considerate and kind to all. His decisions were quickly made and he never spared either his staff or himself for some transient convenience. Therapy was normally administered five times a week at the Institute, from Monday through Friday, but many busy Saturday mornings were spent giving treatment in cases about which Bill Howes was worried. Once, when the elevator was out of order, he helped carry patients back to the wards. He had a fine memory for what troubled his patients, but could not always remember their names. New residents were sometimes startled by his abrupt questioning about someone who was adequately identified in his own mind as "the lady upstairs with the earache," but who was otherwise anonymous. He never said a harsh word to a patient but could be short with a miscreant staff member. His, "Now, Doctor!!", accompanied by a violent shaking of the forefinger, became famous as a sure sign that someone was about to hear the law laid down. But even this had no sting. He knew that his byplay was affectionately mimicked by his staff and, in any case, he would be contrite a moment later for fear that someone's feelings might have been needlessly bruised. His residents came from many parts of the world and were of all races. He never knew the color of their skin, but only if they were good or bad.

From time to time Dr. Howes started on some hobby but he was so busy with his practice that he had little leisure for himself or his family. Once he owned an airplane but found himself supporting a pilot because he had no time to learn to fly. He sold the plane to buy more radium.

In 1951, at the age of 57, Dr. Howes severed his Brooklyn connections and took the position of Radiologist at the Hilo Memorial Hospital in Hawaii. During his "retirement" he was busy establishing a tumor clinic and isotope laboratory. His unexpected death was a shock to his many friends. He loved the sea, and his ashes were strewn over the water.

MORTIMER R. CAMIEL, M.D.

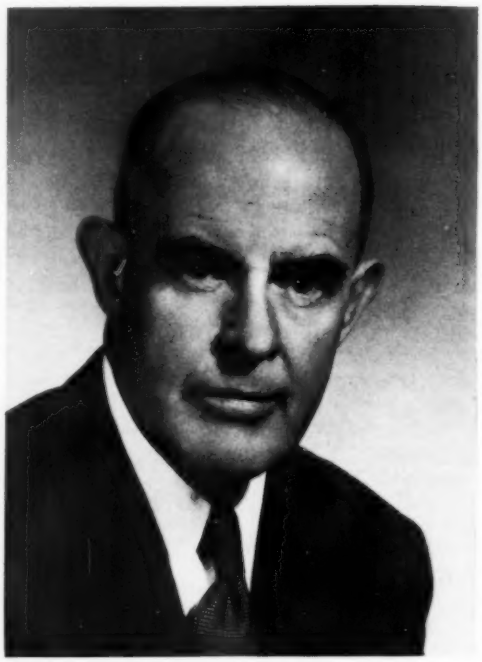
DAVIS SPANGLER, M.D.
1892–1952

Dr. Davis Spangler, well known Texas radiologist, died on April 13, 1952, of a heart ailment recurrent after a previous attack in the summer of 1951.

Dr. Spangler was born in Washington, D. C., Sept. 30, 1892, a son of Wm. A. and Mary (Davis) Spangler. He attended high school in Bonham, Texas, and was graduated in medicine from the University of Texas (Medical Branch in Galveston) in 1913. After serving two internships, one at John Sealy Hospital in Galveston and the other at St. Vincent's Sanitarium in Sherman, Texas, he began practice in Sherman, where he remained until 1921 except for two years in military service. He enlisted in the army in 1917 and, following training in military radiology in Kansas City, Mo., was sent to France. There he was assigned to Base Hospitals No. 31 and No. 36 as radiologist. He was discharged in 1919 with the rank of captain.

In 1921, Dr. Spangler joined the newly organized Dallas Medical and Surgical Clinic. He resigned from this group in 1938 and entered upon practice in the Medical Arts Building, where he continued to devote himself to his specialty until his final illness. During recent years he was associated with Dr. Glenn D. Carlson, Dr. Wm. G. McPheron, and Dr. W. H. Barekman.

Upon graduating from medical school, Dr. Spangler joined the Texas Medical Association through Grayson County Medical Society. He maintained his membership in the state organization and in the American Medical Association, more recently through the Dallas County Medical Society, which he served as president in 1943. He was secretary of the section on Radiology and Physiotherapy of the state group in 1937 and again in 1950. During World War II, he was county chairman of procurement and assignment of physicians. He was a member of the Fort Worth-Dallas Intercity Radiological Club, Dallas Southern Clinical Society, Texas Radiological Society, American Roentgen Ray Society, and the Radiological Society of North America, of which he was twice a Vice-President. He was a fellow of the American College of Radiology and a councilor for that organization in recent years. He was a diplomate of the American Board of Radiology.



Davis Spangler M.D.

Dr. Spangler served as Clinical Assistant Professor of Radiology at Southwestern Medical School of the University of Texas, and on the medical staffs of the Scottish Rite Hospital for Crippled Children, Children's Medical Center, and Medical Arts Hospital. He was a member of the Methodist Church, Kiwanis Club, Dallas Country Club, High Noon Club, Knife and Fork Club, and Koon Kreek Klub of Athens, Texas. He was a sports fan, especially enjoying hunting and fishing.

An enthusiastic Mason, Dr. Spangler held the highest honor in Scottish Rite Masonry, the 33rd degree, and was Potentate in Hella Temple Shrine. He was a member of various other masonic orders, a junior general elect in St. Mark's Conclave, and an honorary member of the Royal Order of the Ducks and the Royal Order of the Jesters.

"Dave" Spangler leaves behind him a host of friends in and out of radiology. He will be deeply mourned and greatly missed. Those closely associated with him in practice will long remember his zeal in attacking the task at hand. During his final illness he gave unsparingly of his energy to a current economic problem in radiology, even at the risk of personal physical disability.

Surviving Dr. Spangler is his wife, the former Mrs. Aurelia Cockrell Kurth, whom he married in 1942.

GLENN D. CARLSON, M.D., F.A.C.R.

RADIOLOGICAL SOCIETIES: SECRETARIES AND MEETING DATES

Editor's Note: Secretaries of state and local radiological societies are requested to co-operate in keeping this section up-to-date by notifying the editor promptly of changes in officers and meeting dates.

RADIOLOGICAL SOCIETY OF NORTH AMERICA. *Secretary-Treasurer*, Donald S. Childs, M.D., 713 E. Genesee St., Syracuse 2, N. Y.

AMERICAN RADIUM SOCIETY. *Secretary*, John E. Wirth, M.D., 635 Herkimer St., Pasadena 1, Calif.

AMERICAN ROENTGEN RAY SOCIETY. *Secretary*, Barton R. Young, M.D., Germantown Hospital, Philadelphia 44, Penna.

AMERICAN COLLEGE OF RADIOLOGY. *Exec. Secretary*, William C. Stronach, 20 N. Wacker Dr., Chicago 6.

SECTION ON RADIOLOGY, A. M. A. *Secretary*, Paul C. Hodges, M.D., 950 East 59th St., Chicago.

Alabama

ALABAMA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, J. A. Meadows, Jr., M.D., Medical Arts Bldg., Birmingham 5.

Arizona

ARIZONA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, R. Lee Foster, M.D., 15 East Monroe, Phoenix. Annual meeting with State Medical Association; interim meeting in December.

Arkansas

ARKANSAS RADIOLOGICAL SOCIETY. *Secretary*, Fred Hames, M.D., Pine Bluff. Meets every three months and at meeting of State Medical Society.

California

CALIFORNIA MEDICAL ASSOCIATION, SECTION ON RADIOLOGY. *Secretary*, Calvin L. Stewart, M.D., 2330 First Ave., San Diego.

EAST BAY ROENTGEN SOCIETY. *Secretary*, Dan Tucker, M.D., 434 30th St., Oakland 9. Meets monthly, first Thursday, at Peralta Hospital.

LOS ANGELES RADIOLOGICAL SOCIETY. *Secretary*, John B. Hamilton, M.D., 210 N. Central Ave., Glendale 3. Meets monthly, second Wednesday, Los Angeles County Medical Association Bldg.

NORTHERN CALIFORNIA RADIOLOGICAL CLUB. *Secretary*, G. A. Fricker, Sacramento Co. Hospital, Sacramento 17. Meets at dinner last Monday of September, November, January, March, and May.

PACIFIC ROENTGEN SOCIETY. *Secretary*, L. Henry Garland, M.D., 450 Sutter St., San Francisco 8. Meets annually at time of California State Medical Association convention.

SAN DIEGO RADIOLOGICAL SOCIETY. *Secretary*, Rex Uncapher, M.D., 7720 Girard Ave., La Jolla. Meets first Wednesday of each month.

SAN FRANCISCO RADIOLOGICAL SOCIETY. *Secretary*, I. J. Miller, M.D., 2680 Ocean Ave., San Francisco 27. Meets quarterly, at the University Club.

SOUTH BAY RADIOLOGICAL SOCIETY. *Secretary*, Ford Shepherd, M.D., 526 Soquel Ave., Santa Cruz. Meets monthly, second Wednesday.

X-RAY STUDY CLUB OF SAN FRANCISCO. *Secretary*, Charles E. Duisenberg, M.D., Palo Alto Clinic, 300 Homer Ave., Palo Alto. Meets third Thursday at 7:45, January to June at Stanford University Hospital, July to December at San Francisco Hospital.

Colorado

COLORADO RADIOLOGICAL SOCIETY. *Secretary*, Wendell P. Stampfli, M.D., 1933 Pearl St., Denver. Meets monthly, third Friday, at University of Colorado Medical Center or Denver Athletic Club.

Connecticut

CONNECTICUT STATE MEDICAL SOCIETY, SECTION ON RADIOLOGY. *Secretary*, Fred Zaff, M.D., 135 Whitney Ave., New Haven. Meets bimonthly, second Wednesday.

CONNECTICUT VALLEY RADIOLOGICAL SOCIETY. *Secretary*, B. Bruce Alicandri, M.D., 20 Maple St., Springfield, Mass. Meets second Friday of October and April.

District of Columbia

RADIOLOGICAL SECTION, DISTRICT OF COLUMBIA MEDICAL SOCIETY. *Secretary*, U. V. Wilcox, M.D., 915 19th St., N.W., Washington 6. Meets third Thursday, January, March, May, and October, at 8:00 P.M., in Medical Society Library.

Florida

FLORIDA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, A. Judson Graves, M.D., 2002 Park St., Jacksonville. Meets in April and in November.

GREATER MIAMI RADIOLOGICAL SOCIETY. *Secretary*, Maurice Greenfield, M.D., Ingraham Bldg., Miami. Meets monthly, third Wednesday, 8:00 P.M., Veterans Administration Bldg., Miami.

Georgia

ATLANTA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Albert A. Rayle, Jr., M.D., 478 Peachtree St. Meets second Friday, September to May.

GEORGIA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Robert M. Tankesley, M.D., 218 Doctors Bldg., Atlanta. Meets in November and at the annual meeting of the State Medical Association.

RICHMOND COUNTY RADIOLOGICAL SOCIETY. *Secretary*, Wm. F. Hamilton, Jr., M.D., University Hospital, Augusta.

Hawaii

RADIOLOGICAL SOCIETY OF HAWAII. *Secretary*, Col. Alexander O. Haff, Tripler Army Hospital, Honolulu. Meets monthly on the third Friday, at Tripler Army Hospital.

Illinois

CHICAGO ROENTGEN SOCIETY. *Secretary*, Elbert K. Lewis, M.D., 6337 S. Harvard Ave., Chicago 21. Meets at the University Club, second Thursday of October, November, January, February, March, and April at 8:00 P.M.

ILLINOIS RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Stephen L. Casper, M.D., Physicians and Surgeons Clinic, Quincy.

ILLINOIS STATE MEDICAL SOCIETY, SECTION ON RADIOLOGY. *Secretary*, George E. Irwin, Jr., M.D., 427 N. Main St., Bloomington.

Indiana

INDIANA ROENTGEN SOCIETY. *Secretary-Treasurer*, John A. Robb, M.D., 23 East Ohio St., Indianapolis. Annual meeting in May.

Iowa

IOWA X-RAY CLUB. *Secretary*. James McMillen, M.D., 1104 Bankers Trust Bldg., Des Moines. Meets during annual session of State Medical Society, and holds a scientific session in the Fall.

Kansas

KANSAS RADIOLOGICAL SOCIETY. *Secretary*, Charles M. White, M.D., 3244 East Douglas, Wichita 8. Meets annually with State Medical Society.

Kentucky

KENTUCKY RADIOLOGICAL SOCIETY. *Secretary*, Everett L. Pirkey, M.D., Louisville General Hospital. Meets monthly, second Friday, at Seelbach Hotel, Louisville.

Louisiana

ORLEANS PARISH RADIOLOGICAL SOCIETY. *Secretary*, Joseph V. Schlosser, M.D., Charity Hospital of Louisiana, New Orleans 13. Meets first Tuesday of each month.

SHREVEPORT RADIOLOGICAL CLUB. *Secretary*, W. R. Harwell, M. D., 608 Travis St. Meets monthly September to May, third Wednesday.

Maine

MAINE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Clark F. Miller, M.D., Central Maine General Hospital, Lewiston. Meets three times a year—Spring, Summer, and Fall.

Maryland

BALTIMORE CITY MEDICAL SOCIETY, RADIOLOGICAL SECTION. *Secretary-Treasurer*, Richard B. Hanchett, M.D., 705-6, Medical Arts Bldg., Baltimore 1. Meets third Tuesday, September to May.

Michigan

DETROIT X-RAY AND RADIUM SOCIETY. *Secretary*, James C. Cook, M D., Harper Hospital, Detroit 1. Meets first Thursday, October to May, at Wayne County Medical Society club rooms.

Minnesota

MINNESOTA RADIOLOGICAL SOCIETY. *Secretary*, Leo A. Nash, M.D., 572 Lowry Medical Arts Bldg., St. Paul 2. Meets in Spring and Fall.

Mississippi

MISSISSIPPI RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, John W. Evans, M.D., 621 High St., Jackson 2, Miss. Meets monthly, third Tuesday, at 6:30 P.M., at the Rotisserie Restaurant, Jackson.

Missouri

RADIOLOGICAL SOCIETY OF GREATER KANSAS CITY. *Secretary*, Sidney Rubin, M.D., 410 Professional Bldg., Kansas City, Mo. Meets last Friday of each month.

ST. LOUIS SOCIETY OF RADIOLOGISTS. *Secretary*, Francis O. Trotter, Jr., M.D., 634 North Grand Blvd., St. Louis 3. Meets on fourth Wednesday, October to May.

Nebraska

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New England

NEW ENGLAND ROENTGEN RAY SOCIETY. *Secretary*, Stanley M. Wyman, M.D., Massachusetts General Hospital, Boston 14. Meets monthly on third Friday, at the Harvard Club, Boston.

New Hampshire

NEW HAMPSHIRE ROENTGEN SOCIETY. *Secretary*, Albert C. Johnston, M.D., 127 Washington St., Keene.

New Jersey

RADIOLOGICAL SOCIETY OF NEW JERSEY. *Secretary*, Nicholas G. Demy, M.D., 912 Prospect Ave., Plainfield. Meets at Atlantic City at time of State Medical Society and midwinter in Elizabeth.

New York

BUFFALO RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Mario C. Gian, M.D., 610 Niagara St., Buffalo 1. Meets second Monday, October to May.

CENTRAL NEW YORK ROENTGEN SOCIETY. *Secretary*, Dwight V. Needham, M.D., 608 E. Genesee St., Syracuse 2. Meets in January, May, October

KINGS COUNTY RADIOLOGICAL SOCIETY. *Secretary*, Marcus Wiener, M.D., 1430 48th St., Brooklyn 19. Meets fourth Thursday, October to April (except December), at 8:45 P.M., Kings County Medical Bldg.

NASSAU RADIOLOGICAL SOCIETY. *Secretary*, Joseph J. La Vine, M.D., 259 North Grand Avenue, Baldwin, N.Y. Meets second Tuesday, February, April, June, October, and December.

NEW YORK ROENTGEN SOCIETY. *Secretary*, Irving Schwartz, M.D., 45 E. 66th St., New York 21.

NORTHEASTERN NEW YORK RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, John F. Roach, M.D., Albany Hospital, Albany. Meets at University Club, Albany, second Wednesday, October, November, and March. Annual meeting in June.

ROCHESTER ROENTGEN-RAY SOCIETY. *Secretary-Treasurer*, Robert J. Bloor, 260 Crittenden Blvd. Meets at Strong Memorial Hospital, last Monday of each month, September through May.

WESTCHESTER RADIOLOGICAL SOCIETY. *Secretary*, Walter J. Brown, M.D., Northern Westchester Hospital, Mount Kisco, N. Y. Meets third Tuesday of January and October and at other times as announced.

North Carolina

RADIOLOGICAL SOCIETY OF NORTH CAROLINA. *Secretary*, Waldemar C. A. Sternbergh, 1400 Scott Ave., Charlotte 2. Meets in April and October.

North Dakota

NORTH DAKOTA RADIOLOGICAL SOCIETY. *Secretary*, P. H. Woutat, M.D., 221 S. 4th St., Grand Forks.

Ohio

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CENTRAL OHIO RADIOLOGICAL SOCIETY. *Secretary*, Frank A. Riebel, M.D., 15 W. Goodale St., Columbus. Meets second Thursday, October, December, February, April, and June, 6:30 P.M., Columbus Athletic Club, Columbus.

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MIAMI VALLEY RADIOLOGICAL SOCIETY. *Secretary*, Geo. A. Nicoll, M.D., Miami Valley Hospital, Dayton. Meets monthly, second Friday.

Oklahoma

OKLAHOMA STATE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, John R. Danstrom, M.D., Medical Arts Bldg., Oklahoma City.

Oregon

OREGON RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, J. Richard Raines, M.D., Medical-Dental Bldg., Portland 5. Meets monthly, second Wednesday, October to June, at 8:00 P.M., University Club.

Pacific Northwest

PACIFIC NORTHWEST RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Sydney J. Hawley, M.D., 1320 Madison St., Seattle 4. Meets annually in May.

Pennsylvania

PENNSYLVANIA RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, James M. Converse, M.D., 416 Pine St., Williamsport 8. Meets annually.

PHILADELPHIA ROENTGEN RAY SOCIETY. *Secretary*, George P. Keefer, M.D., American Oncologic Hospital, Philadelphia 4. Meets first Thursday of each month at 5:00 P.M., from October to May, in Thompson Hall, College of Physicians.

PITTSBURGH ROENTGEN SOCIETY. *Secretary-Treasurer*, Edwin J. Euphrat, M.D., 3500 Fifth Ave., Pittsburgh 13. Meets monthly, second Wednesday, at 6:30 P.M., October to May, at Webster Hall.

Rocky Mountain States

ROCKY MOUNTAIN RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Maurice D. Frazer, M.D., 1037 Stuart Bldg., Lincoln, Nebr. Next annual meeting Aug. 7–9, 1952, in Denver.

South Carolina

SOUTH CAROLINA X-RAY SOCIETY. *Secretary-Treasurer*, Henry E. Plenge, M.D., 855 N. Church St., Spartanburg. Meets with State Medical Association in May

South Dakota

RADIOLOGICAL SOCIETY OF SOUTH DAKOTA. *Secretary-Treasurer*, Marianne Wallis, M.D., 1200 E. Fifth Ave., Mitchell. Meets during annual meeting of State Medical Society.

Tennessee

MEMPHIS ROENTGEN CLUB. *Secretary*, John E. Whiteleather, M.D., 899 Madison Ave. Meets first Monday of each month at John Gaston Hospital.

TENNESSEE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, J. Marsh Frère, M.D., Newell Hospital, Chattanooga 2. Meets annually with State Medical Society in April.

Texas

DALLAS-FORT WORTH ROENTGEN STUDY CLUB. *Secretary*, Claude Williams, M.D., Fort Worth. Meets monthly, third Monday, in Dallas odd months, Fort Worth even months.

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TEXAS RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, R. P. O'Bannon, M.D., 650 Fifth Ave., Fort Worth. Next meeting Jan. 23–24, 1953, San Antonio.

Utah

UTAH STATE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Angus K. Wilson, M.D., 343 S. Main St., Salt Lake City 1. Meets third Wednesday, January, March, May, September, November

Virginia

VIRGINIA RADIOLOGICAL SOCIETY. *Secretary*, P. B. Parsons, M.D., Norfolk General Hospital, Norfolk.

Washington

WASHINGTON STATE RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, John N. Burkey, M.D., 555 Medical-Dental Bldg., Seattle. Meets fourth Monday, September through May, at College Club, Seattle.

Wisconsin

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SECTION ON RADIOLOGY, STATE MEDICAL SOCIETY OF WISCONSIN. *Secretary*, Abraham Melamed, M.D., 425 E. Wisconsin Ave., Milwaukee 2. Meets in October with State Medical Society.

UNIVERSITY OF WISCONSIN RADIOLOGICAL CONFERENCE. Meets first and third Thursday at 4 P.M., September to May, Service Memorial Institute.

WISCONSIN RADIOLOGICAL SOCIETY. *Secretary-Treasurer*, Irving I. Cowan, M.D., 425 East Wisconsin Ave., Milwaukee 2.

CANADA

CANADIAN ASSOCIATION OF RADIOLOGISTS. *Honorary Secretary-Treasurer*, Jean Bouchard, M.D. Assoc. Hon. Secretary-Treasurer, D. L. McRae, M.D. *Central Office*, 1555 Summerhill Ave., Montreal 26, Quebec. Meets in January and June.

LA SOCIÉTÉ CANADIENNE-FRANÇAISE D'ELECTROLOGIE ET DE RADIOLOGIE MÉDICALES. *General Secretary*, Origène Dufresne, M.D., Institut du Radium, Montreal. Meets third Saturday each month.

CUBA

SOCIEDAD DE RADIOLOGÍA Y FISIOTERAPÍA DE CUBA. Offices in Hospital Mercedes, Havana Meets monthly.

MEXICO

SOCIEDAD MEXICANA DE RADIOLOGÍA Y FISIOTERAPÍA. *General Secretary*, Dr. Dionisio Pérez Cosío, Marsella 11, Mexico, D.F. Meets first Monday of each month.

PANAMA

SOCIEDAD RADIOLÓGICA PANAMEÑA. *Secretary-Editor*, Luis Arrieta Sánchez, M.D., Apartado No. 86, Panama, R. de P.

PUERTO RICO

ASOCIACIÓN PUERTORRIQUEÑA DE RADIOLOGÍA. *Secretary*, Jesús Rivera Otero, M.D., Box 3542 Santurce, Puerto Rico.

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ROENTGEN DIAGNOSIS

THE HEAD AND NECK

Pneumoencephalographic Study of Cerebrospinal-Fluid Absorptive-Block Mechanisms. A Study of the Mechanism Involved in Production of Increased Intracranial Pressure. Robert B. Aird and David Zealear. Arch. Neurol. & Psychiat. **66:** 199–212, August 1951.

The dynamic equilibrium of the cerebrospinal fluid is controlled by its relative rates of formation and absorption. Abnormalities of the absorptive mechanism are most commonly encountered in pathological conditions, since the usual margin of safety in this mechanism is sufficient to compensate for all ordinary, and probably most abnormal, alterations in cerebrospinal-fluid formation. The most common cause of an alteration in the hydrodynamic balance of cerebrospinal fluid is to be found in processes which obstruct the absorptive bed or the subarachnoid channels leading to it.

Pneumoencephalography affords the best available method of study of the absorptive bed and the subarachnoid channels. The characteristic roentgenographic picture associated with an absorptive block consists of small or obliterated subarachnoid spaces and dilated or large "normal" ventricular spaces. These findings, in combination with a delay in the rate of absorption of a gas, such as ethylene, following its pneumoencephalographic injection, form a triad characteristic of an absorptive block.

Pneumoencephalographic studies of 630 patients with ethylene and oxygen gases are reported by the authors. Delayed or borderline disappearance of the gas was observed in 56 per cent of patients with a history suggestive of meningoencephalitis and in 47 per cent of patients with brain tumors. Only 10 per cent of patients in the group with idiopathic epilepsy showed a delay in the rate of absorption of gases. These findings indicated to the authors that the rate of disappearance of ethylene after its pneumoencephalographic injection is a relatively sensitive test of a partial obstructive process and is capable of indicating such partial obstructions even before an impairment of cerebrospinal-fluid circulation, with a consequent increase of intracranial pressure, has occurred.

The fact that this triad of signs was observed in a significant number of patients with brain tumors suggests a common absorptive-block mechanism for all space-consuming and inflammatory lesions of the central nervous system. The explanation of increased intracranial pressure in the presence of dilated and unobstructed ventricles has not been clear on a simple space-consuming basis. An alternate mechanism suggested by this study, whereby space obliterating processes, either neoplastic or inflammatory, may produce subarachnoid block, impairment of cerebrospinal-fluid circulation, and increased intracranial pressure, is discussed.

Six roentgenograms; 4 tables.

O. W. Doyle, M.D.
University of Michigan

Senile Circumscribed Concentric Osteoatrophy of the Cranial Vault. Václav Bek. Acta radiol. et cancerol. bohemoslovenica **5:** 95–98, 1951.

Two female patients, aged 76 and 65, were found incidentally to have rarefaction of both parietal bones, demonstrable in a lateral film as a wide stripe taking a curved course along the sagittal axis. This picture evidently was due to the disappearance of the lamina externa and the diploe of the vault down to the lamina interna, which was normal. No sclerotic margin was noted. The condition is regarded as a senile atrophic change rather than a developmental anomaly. [Most American authors favor the view that such changes are of developmental origin.]

Five roentgenograms.

Charles M. Nice, M.D.
University of Minnesota

A Complication of Percutaneous Carotid Angiography. Hans Idbohrn. Acta radiol. **36:** 155–160, August 1951.

Left carotid angiography by the percutaneous method was attempted in a 40-year-old man suspected of having a cerebral tumor. The left common carotid was punctured at its bifurcation. A few moments after injection of 10 c.c. of contrast medium, the patient lost consciousness and respiration became labored. He recovered consciousness in ten minutes. The roentgenograms showed most of the contrast medium deposited in the wall of the common carotid artery, causing a semilunar bulge inward of the innermost arterial coat just above the bifurcation, with consequent narrowing of the lumen at the bifurcation.

The examination was repeated in twenty-four hours and disclosed an intraluminal filling defect at the site of the initial examination. The patient died of glioblastoma multiforme approximately one week later. At autopsy, at the site of the first angiographic puncture, an intramural hematoma 6 cm. long was found.

Three roentgenograms; 1 photograph.

I. R. Berger, M.D.
VA Hospital, Chamblee, Ga

THE CHEST

Variations in the Bronchovascular Patterns of the Right Lower Lobe of Fifty Lungs. Ronald M. Ferry, Jr., and Edward A. Boyden. J. Thoracic Surg. **22:** 188–201, August 1951.

In a previous article by Smith and Boyden (J. Thoracic Surg. **18:** 195, 1949. Abst. in Radiology **54:** 446, 1950), the principal variations in the distribution and arrangement of the segmental bronchi were established, first by injections and then by dissection of injected specimens. At that time, even if the technic had permitted, it would not have been feasible to analyze the vascular patterns owing to their complexity and the necessity of first mastering the bronchial variations. Nevertheless, it was recognized that a knowledge of the arrangement of arteries and veins is as essential to segmental resection or lobectomy as familiarity with bronchial patterns. Indeed, the present study has shown that such malarrangements as the splitting of the medial basal bronchus by the basal branches of the inferior pulmonary vein may prevent the resection of that segment even though the bronchogram might not suggest the danger of resection to the uninitiated observer.

Analysis of the segmental bronchi, veins, and arteries in 50 dissected specimens of the right lower lobe has led to the conclusion that the most important relation

in the basal half of the lobe is that between the bronchi of the medial basal segment and the large venous trunks which enter the inferior pulmonary vein.

Seven plates in color; 2 drawings; 5 tables.

Origin of the Lobus Venae Cardinalis (Azygos Lobe). P. Lutz. Fortschr. a. d. Geb. d. Röntgenstrahlen **75:** 30–33, July 1951. (In German)

After summarizing the previous theories as to the origin of the azygos lobe, the author gives the newer views regarding its genesis. In the early stage of embryonal development, the cardinal veins are the chief vessels for draining the regions caudal to the heart. They lie dorsally in the folds of the mesonephros, one to either side of the spinal anlage. During development of the kidneys, the vein is drawn laterally and a new vein appears, the supracardinal, which lies anterolateral to the vertebrae and medial to the mesonephros. Early in the course of development there is a forward bulging of the vein, but the arch remains relatively stationary. This results in more or less upward displacement of the arch as the heart descends.

During the later developmental stages the posterior cardinal vein is normally obliterated and the remaining supracardinal vein becomes the azygos. No accessory lobe is developed in this process. With persistence of the cranial portion of the posterior cardinal vein, however, which forms an abnormally large cranial segment, becoming the upper portion while the supracardinal vein forms the spinal portion of the azygos, an accessory lobe is formed, giving the typical roentgen picture.

One roentgenogram; 3 drawings.

E. W. SPACKMAN, M.D.
Fort Worth, Texas

Bronchography as an Aid in Planning Surgical Treatment of Pulmonary Tuberculosis. With a Preliminary Note on Pulmonary Angiography. Joseph Gordon, W. Berkeley Zinn, Ray Brook, and Philip C. Pratt. J. Thoracic Surg. **22:** 109–134, August 1951.

Bronchograms give considerable information as to the exact location and extent of pulmonary involvement and the amount of functionally available lung tissue remaining in patients with tuberculosis. No harmful effects of the iodized oil have been demonstrated in patients with either positive or negative sputum. Small quantities of oil are employed, and postural drainage achieves its practically complete removal. The procedure should not be used in patients with actively progressive disease or excessive secretions because of risk of spread of the infection or retention of secretions by block of cough reflex under topical anesthesia.

Aqueous opaque solutions are not recommended for routine use because sufficient detail is not obtained. They are valuable, however, where marked stenosis of a main bronchus prevents adequate filling by an oily medium.

Any disadvantages of bronchography are held to be outweighed by the important preoperative information thus obtainable: (1) accurate localization of the diseased lung segments prior to resection; (2) demonstration of structural changes in areas where routine examination has indicated "clearing," thus determining the extent of a proposed thoracoplasty; (3) demonstration of the extent of structural change in a collapsed lung, enabling proper decision as to the advisability of decortication.

Angiographic studies of the pulmonary circulation show a positive correlation between vascular and bronchial structural changes in chronic pulmonary tuberculosis, providing additional information for use in planning surgical treatment.

Extremely valuable roentgenographic information was obtained in the study reported here by detailed correlation of the x-ray and pathologic findings. Surgical and autopsy lung specimens were injected *via* bronchi and pulmonary arteries. Films of the injected specimens were then compared with and interpreted in the light of gross and microscopic pathologic study.

Seventy-nine roentgenograms; 3 photographs; 8 photomicrographs. DONALD DEF. BAUER, M.D.
St. Paul, Minn.

Influenzal Pneumonia—Recent Experiences. B. B. Harrison. Brit. J. Radiol. **24:** 392–397, July 1951.

In a recent epidemic of influenza, 80 cases of influenzal pneumonia were seen in a Liverpool Hospital. The pneumonia usually appeared following a short period of apparent recovery from the acute influenzal attack, the interval averaging seven days. Most of the patients were in the older group, the average age being 55.1 years. Twenty died, having shown little response to treatment.

The radiographic appearance is variable. Commonest in the early stages are multiple areas of infiltration, soft in character, with ill defined edges. These may be bilateral and approximately symmetrical, or may be predominantly one-sided. In later stages several may coalesce. Sometimes the appearance is that of miliary infiltrations resembling miliary tuberculosis, miliary metastasis or silicosis. Occasionally frank areas of consolidation occur. Cavitation is sometimes present. With recovery, the lesions disappear after ten days or more.

Twelve roentgenograms.

SYDNEY J. HAWLEY, M.D.
Seattle, Wash.

Artificial Pneumothorax: A Statistical Analysis of 557 Cases Initiated in 1930–1939 and Followed in 1949. IV. Incidence, Mortality, and Factors Associated with Complicating Tuberculous Empyema. Roger S. Mitchell. Am. Rev. Tuberc. **64:** 127–140, August 1951.

This report is based on 557 cases of artificial pneumothorax previously studied by the author (Am. Rev. Tuberc. **64:** 1, 21, 27, 1951. Abst. in Radiology **58:** 759, 1952), plus an additional 48 cases. Tuberculous empyema is here defined as a cloudy or grossly purulent pleural fluid in which acid-fast bacilli can be found on concentrated smear or *M. tuberculosis* on culture.

The incidence of tuberculous empyema occurring during the ten to twenty years after induction of pneumothorax, namely 18.2 per cent, is somewhat higher than in most reports, and the total mortality, 43.6 per cent, is somewhat lower. The highest mortality (15.4 per cent) occurred in the first year after the onset of empyema, the figure decreasing gradually to 1.4 per cent in the seventh and eighth years. The mortality also was somewhat dependent upon the time of onset of the complication after induction, with a lower mortality in the cases with a late empyema than in those occurring earlier. The incidence of empyema was definitely higher in males than in females and in patients over thirty-five than in the younger age groups.

A definite relationship was found between the density of roentgenographic shadows, reflecting the character of the primary disease, and empyema, with an incidence of 3 per cent in cases with "light" and 25.5 per cent in cases with "heavy" shadows. Very little relationship was found between cavity wall thickness and cavity size and the occurrence of empyema except in large cavities (above 6.5 cm. diameter), where a definite increase in incidence was noted. Apical cavitation was found to be associated with empyema more often than similar disease in the mid-lung and base. In patients with endobronchial disease, empyema was more common than in those in whom no radiographic evidence of involvement could be demonstrated. When the involvement of a bronchus was manifested by sudden airlessness and contraction of a lung or lobe following induction of pneumothorax, the incidence of empyema was found to be particularly high (48.2 per cent), in comparison to a low incidence (15.5 per cent) in patients without such changes.

Bed rest for four or more months before induction of pneumothorax reduced the incidence of empyema to 12.3 per cent as compared to 20.3 per cent in patients who had less or no bed rest. Another important factor was anatomic freedom from adhesions, the incidence ranging from 23.8 per cent in patients with "very poor" collapse to 8.2 per cent in those with "excellent" collapse.

As in the previous reports by this author, the results are summarized in a series of tables.

JOHN H. JUHL, M.D.
University of Wisconsin

Artificial Pneumothorax: A Statistical Analysis of 557 Cases Initiated in 1930–1939 and Followed in 1949. V. Incidence, Degree, and Causative Factors of Pulmonary Contraction or "Unexpandable Lung." Roger S. Mitchell. Am. Rev. Tuberc. **64**: 141–150, August 1951.

In this report the author could use only 312 of the 557 cases previously studied (see preceding abstract) since bilateral pneumothorax cases were excluded. Films taken two or more years after abandonment of pneumothorax and before the use of other collapse or surgical treatment were compared with films of the chest taken before and during pneumothorax. No pulmonary contraction was found in 17 per cent. Some degree of contraction was noted in the remainder, with 5 to 20 per cent contraction in 16 per cent, 25 to 40 per cent contraction in 16 per cent, 45 to 60 per cent contraction in 16 per cent, 65 to 80 per cent contraction in 21 per cent and 85 to 100 per cent contraction in the remaining 14 per cent.

The incidence and degree of contraction were found to be related to empyema. Thus, of 52 cases with empyema, 71.2 per cent showed marked contraction. Duration of pneumothorax was also important, with an increasing incidence of significant contraction as the duration of the pneumothorax increased. Marked contraction was found in 77.8 per cent of cases in which roentgenographic evidence of major bronchial disease developed after induction of pneumothorax. The strong influence of duration of pneumothorax on the incidence and degree of pulmonary contraction is a good argument for limiting the duration of pneumothorax to a practicable minimum period.

A number of other factors were studied which had no significant relationship to incidence and degree of contraction; among them were age of the patient, density of shadows, estimated age of the disease, duration of rest before induction, anatomic freedom from adhesions, speed of cavity closure, speed of sputum conversion, and duration of rest after induction.

One figure; 9 tables. JOHN H. JUHL, M.D.
University of Wisconsin

Artificial Pneumothorax: A Statistical Analysis of 557 Cases Initiated in 1930–1939 and Followed in 1949. VI. Results in Various Selected Series of Cases. Roger S. Mitchell. Am. Rev. Tuberc. **64**: 151–158, August 1951.

The application of the results of pneumothorax previously reported (see preceding abstracts) is the subject of the present report. The results are tabulated and conclusions drawn from them. The author suggests the following criteria for selection of cases for pneumothorax:

1. The roentgenographics hadows of the disease to be treated should be light, fluffy, and scattered, rather than heavy, dense, or grossly confluent.
2. The extent of destruction as measured by (*a*) extent of cavitation, (*b*) extent of presumed caseation, and (*c*) degree of contraction resulting from old disease, obstructive factors, or both, is a much more reliable guide in the selection of cases for pneumothorax than is cavity size alone.
3. Location of disease need play only a minor role in the selection of cases for pneumothorax.
4. Some contraindications to the use of pneumothorax are: (*a*) old fibroid disease, (*b*) cavity in the contralateral lung, (*c*) any clinical or roentgenographic evidence of major bronchial obstruction.

The following considerations appear to be important in the management of pneumothorax:

1. Free anatomic collapse should be obtained.
2. Sudden persistent atelectasis of a lobe or lobes soon after induction is a strong indication for abandonment.
3. If cavity closure and sputum "conversion" do not occur within three to four months, abandonment is advised.

From the above statements it is apparent that the use of pneumothorax should be distinctly limited. If the criteria are followed, satisfactory results may be expected.

Three tables. JOHN H. JUHL, M.D.
University of Wisconsin

Roentgen Diagnosis of Neoplastic Disease of the Lungs. L. R. Sante. South. M. J. **44**: 717–724, August 1951.

X-ray examination of the chest is one of the most effective means of detecting malignant lesions of the lung. In the early stages of the disease the symptoms may be so insidious that a serious condition is not suspected. Suggestive of the diagnosis, however, are the following symptoms, present for three months or more, in a person fifty years of age or older: progressive weakness, loss of weight, cough (usually dry), and hemoptysis or blood-streaked sputum, without fever or other evidence of infection. The presence of a parenchymal lesion on x-ray examination of the chest in addition to such symptomatology can be considered as presumptive evidence of cancer, and indication for further investi-

gation, such as biopsy of tissue obtained by bronchoscopy, sputum examination for malignant cells, and microscopic investigation of aspirated fluid.

Various types of lesions are discussed.

Bronchogenic carcinoma of the nodular type originates from the bronchial epithelium, tends to remain localized, first producing obstructive emphysema and later atelectasis.

Bronchogenic carcinoma of the ulcerating type arises from the deeper layers, forms a more bulky mass, and tends to break down and ulcerate so early that it cannot be differentiated from lung abscess. Only rarely is atelectasis associated with this type of growth.

The Pancoast or superior sulcus tumor is not due to any specific cell type. Associated erosion and destruction of adjacent ribs and pressure on adjacent nerves are the characteristic radiologic features.

Primary alveolar-cell carcinoma originates simultaneously in multiple locations in the lung parenchyma, which appear radiographically as small areas of infiltration, coalescing to form areas of massive consolidation.

Endothelioma of the pleura forms nodular masses with the base towards the periphery. Seeding in the pleural space may cause multiple secondary growths.

Primary sarcoma of the lung is rare and presents no characteristic features radiologically.

Benign tumors of the lung appear in younger individuals and more frequently in women, in contrast to malignant growths.

Bronchial adenoma resembles bronchogenic carcinoma, but is slower growing. It is believed by some to be potentially malignant.

Solitary fibroma is a solid fibrous nodule most frequently due to healing of a chronic infection. It may have a laminated appearance.

Neurofibromas are in most instances benign and occur posteriorly. They are usually rounded and smooth.

Hemangioma is a rare lung tumor, with a tendency toward hemorrhage and consequent consolidation resembling a pneumonic process, but persisting longer than pneumonia. Fluoroscopically the lesion may show diminution on performance of Valsalva's maneuver. Diagnosis can be confirmed by angiocardiography.

Teratoid tumors are not uncommon and are seen most often in the mediastinum. Hamartomas are rounded tumors varying greatly in size. They often have flecks of calcium distributed throughout, distinguishing them from dermoids, in which calcification is peripheral.

Primary amyloidosis, paraffinoma of the lung, and various types of cysts are non-neoplastic conditions of differential diagnostic importance which are briefly discussed.

Nine roentgenograms. MASON WHITMORE, M.D.
Jefferson Medical College

Value of Exploration in Silent Lung Disease. Richard H. Overholt. Dis. of Chest **20:** 111–125, August 1951.

Abnormal shadows, easily detected on survey examinations, may in many instances represent any one of a number of pathological conditions, and may not be definitely identifiable without exploration. Many lesions simulate each other, and often a given lesion has different radiographic appearances. Because of radiologic screening, an increasing number of potentially serious lesions are brought under observation at an early stage in their development. This creates a problem in management, for not all of the lesions are malignant.

According to a personal communication from Blomquist, in 10 city-wide surveys sponsored by the U. S. Public Health Service 1,382 possible tumors were found in 1,780,178 persons examined, an incidence of 0.8 per 1,000. The final analysis of this group is not available. Hilbish, also in a personal communication, reported that in Minneapolis, Seattle, and Washington, the yield of primary pulmonary cancer of all types was about 0.1 per 1,000. In a recent survey in Boston (1949), out of 536,012 persons examined, 398 (0.75 per 100) "possible tumor suspects" were discovered. At the time of the present report 333 (83 per cent) of these had been followed, and in 76 a diagnosis of cancer was made, representing 23 per cent of all suspected abnormal shadows.

The cancer potential in patients referred to surgical clinics is higher. In the Overholt Thoracic Clinic, 162 persons were explored for lesions found on survey: 58 tumors were found, of which 39 were malignant. Tuberculosis was discovered in 59, and cysts and other lesions in 45.

The author advises against procrastination, for the proper timing of treatment in cancer has more to do with success than any other single factor. No time should be lost waiting for the results of guinea-pig inoculations or cultures, and there should be no delays for comparison studies of x-ray films or repetitious bronchoscopies. Lung aspirations and needle biopsies are of no practical value, for a negative result does not exclude cancer, and with a positive result exploration still has to be done.

The diagnoses in 200 consecutive intrathoracic explorations are listed. Of 54 cancers, only 21 had been diagnosed preoperatively.

Curability of pulmonary cancer depends upon surgical excision, and success is determined largely by an early localized lesion and the skill of the surgical team. Resectability rates range from 30 per cent in those with symptoms to 100 per cent in those with silent cancers. Of cases treated promptly, about 75 per cent showed no extension. With a delay of three months this percentage fell to 44.

Ten illustrations including 4 roentgenograms; 5 tables. HENRY K. TAYLOR, M.D.
New York, N. Y.

Lipoma of the Bronchus and the Lung. A Report of Two Unusual Cases. Arthur S. W. Touroff and Gabriel P. Seley. Ann. Surg. **134:** 244–250, August 1951.

Only 6 cases of lipoma of the bronchus have been previously recorded and but one of lipoma of the pulmonary parenchyma, the latter discovered postmortem. The authors report here 2 cases: (1) the first instance of lipoma of the lung in a living patient, and (2) a unique "dumbbell" bronchial lipoma, a portion of which lay within the bronchial lumen while the major component extended into the adjacent parabronchial tissues.

A brief review of the literature of bronchial lipomas is presented. Watts, Clagett and McDonald (J. Thoracic Surg. **15:** 132, 1946) stated that in the larger bronchi fat may always be found in the fibrous tissue external to the cartilages, that lesser amounts occur in the submucosa or between the cartilages, and that in the smaller bronchi fat is present in the walls in gradually decreasing amounts until the cartilages disappear.

No fat is to be found in any part of the bronchial tree where cartilage does not occur. On this basis, these writers concluded that lipomas of the major bronchi arise from adipose tissue normally present in the submucosa, while lipomas in the lung parenchyma or beneath the pleura could arise from fat which often is present in the smaller bronchi (1 mm. or more in diameter). The authors of the present paper believe that their cases support this view.

Their first patient was a 60-year-old man in whom the tumor was a coincidental finding in a chest film made because of fever following an unrelated surgical procedure. The roentgenograms disclosed a sharply demarcated oval shadow of low density in the right upper lobe. Its appearance suggested a cyst or sarcoma. Thoracotomy disclosed a mass covered by lung in all aspects, which shelled out without difficulty. In the floor of the defect thus formed a tiny bronchial fistula was seen. Pathological study showed the tumor to be a lipoma, covered by bronchial epithelium and containing a small area of cartilage. Six months later the patient remained well.

The second case was that of a 46-year-old woman with a history of chronic cough and intermittent hemoptysis pointing to endobronchial disease. A chest film disclosed an infiltration in the left base and atelectasis of the left lower lobe. An ovoid mass was seen behind the heart. Thoracotomy revealed a firm, ovoid mass in close relationship to the left lower lobe bronchus. Lobectomy was performed and examination of the specimen showed a dumbbell type of tumor. The endobronchial component, 1.5 × 1.0 cm. in diameter, bright yellow in color and firm in consistency, arose at the junction of the lateral and posterior branches of the lower lobe bronchus. The tumor extended through the bronchial wall, outside of which it formed a mass twice as large as that within the bronchus. The microscopic diagnosis was polypoid endobronchial lipoma.

In their discussion the authors point out that the lipoma of the lung in their first case was asymptomatic by virtue of its position away from the large bronchi. They believe that it probably had its origin from the fat of small cartilage-containing bronchi. In their second case, which apparently arose from normal fat between the cartilages, symptoms were due to occlusion of a large bronchus.

Four roentgenograms; 2 photographs; 1 photomicrograph.

I. R. BERGER, M.D.
VA Hospital, Chamblee, Ga.

Sarcoidosis. Andrew L. Banyai. J. Missouri State M. A. **48**: 613–618, August 1951.

Sarcoidosis is a multisystem disease which may involve any or all of the organs of the body. The most frequent sites are the skin, lymph nodes, lung, spleen, small tubular bones, uveal tract of the eye, and parotid gland. Pathologically it is characterized by tubercles of tissue containing epithelioid cells and giant cells (Langhans type), but with no evidence of caseation. Healing may occur by resorption or fibrosis of the nodules. Because of the protean nature of the disease, symptoms and signs may originate from any organ system and a characteristic syndrome cannot be described. Symptoms are often minimal as compared to the amount of tissue undergoing pathological change. Indefinite malaise, weight loss, weakness, and possibly mild fever herald the early phase.

Radiographically, changes may be demonstrated in the hilar regions, lung parenchyma, and in the small tubular bones. Hilar adenopathy tends to be massive and lobulated. The right paratracheal nodes are rather constantly prominent. Lung parenchymal changes include peribronchial and perivascular infiltration, tending to radiate from the hilus, producing a reticular pattern in the lung fields. The infiltration may be patchy and suggest a pneumonitis. Most frequently seen are small miliary nodules throughout one or both lung fields. The apices and lung bases contain fewer than the central portions of the lung. The nodules vary in size, ranging from 1 to 3 mm. in diameter. Admixtures of the several types of lung and hilar lesions may occur in any proportion.

Bone lesions, chiefly in the small tubular bones of the carpal, metacarpal, tarsal, and metatarsal regions, are small pseudocysts located in the cortex, the result of bone replacement by the sarcoid granulomas. Rarefaction, reticulation, and coarse trabeculation may be seen, and bone expansion without periosteal reaction is not uncommon.

Final diagnosis can be made by biopsy of an involved lymph node and occasionally by examination of aspirated sternal marrow. Diagnosis of sarcoidosis by "trial" x-ray therapy is not satisfactory. Treatment of the disease remains largely symptomatic, since a specific definitive therapy has not yet been demonstrated.

EARL R. HAYNES, M.D.
The Henry Ford Hospital

Pulmonary Haemosiderosis. Philip Ellman and Alexander Gee. Brit. M. J. **2**: 384–390, Aug. 18, 1951.

Pulmonary hemosiderosis occurs in two groups of patients—children and young adults—producing different but characteristic clinical features. The authors describe 5 adult cases, all in association with rheumatic heart disease.

In children the attacks are characterized by sudden development of moderate fever, gross tachycardia and dyspnea, cyanosis, and hemoptysis. The last may be profuse and repeated, though not always obvious, as the blood may be swallowed. The children are of either sex and are often small and underweight. Clubbing of the fingers is common and may regress during remissions. Peripheral hypertension is never found. The most striking feature is a severe anemia, which may present features falsely suggestive of a hemolytic origin. It is suggested that the anemia is secondary to hemorrhage occurring into the lung tissue causing a "damming up" of the liver with excessive blood pigments. However, the anemia has been observed in the absence of radiological evidence of changes in the pulmonary fields. The sputum is devoid of tubercle bacilli but not infrequently shows typical "heart failure" cells. These children die of acute suffocation, with signs of increasing obstruction of the lesser circulation, right heart failure, and terminal left heart failure with pulmonary edema apparently due to the mechanical effects of the extravasated blood.

Radiologically these young patients show miliary mottling, principally in the middle and lower pulmonary zones, and somewhat coarser than that in adult cases. Hilar enlargement is almost constant and due principally to adenopathy, though the conus is often prominent. Nodulation of the silicotic type may be present, and during exacerbations there may be partial lobar atelectasis. The heart contours are usually normal and the pulmonary vessels are not prominent.

In adults the disease occurs in the early decades, usually in association with rheumatic carditis and mitral stenosis. Four-fifths of the patients are males, in contrast to the predominance of females in simple mitral stenosis. A history of recurrent hemoptysis is almost invariable. Physical signs are often minimal or even absent. Peripheral hypertension is rarely present.

Radiologically there is miliary mottling in the middle and lower zones, sparing the apices. This is constant over long periods. The nodules are regularly disseminated, usually 1 to 3 mm. in diameter, discrete, dense, and with a relative central translucency representing a terminal bronchiole surrounded by a rosette of opaque alveoli. They are superimposed on a fine reticular background. There is also a uniform increased over-all density, due to pulmonary edema. The mitral configuration of the heart and increased vascular pattern at the hili is usual.

Differentiation from simple congestive failure is largely made by the constancy of the changes; from miliary tuberculosis by the sparing of the apices and the increased hilar shadows; from sarcoid by absence of nodular changes in the hili; from pneumoconiosis by lack of history of exposure (industrial siderosis may be very similar); and from carcinomatosis by absence of cachexia and evidence of a primary growth.

Lung puncture and the obtaining of "heart failure" cells may be helpful in diagnosis. Pathologically the cut lung surface shows numerous tiny nodules which give a strongly positive Prussian-blue staining reaction due to the hemosiderin. These "spots" are formed by groups of adjacent alveoli stuffed full of "heart failure" cells with the vascular and stromal tissues showing incrustation with free hemosiderin deposits. Regional nodes show only traces of iron.

The five cases are discussed in detail. Four of the patients were males with a history of recurrent hemoptysis and typical roentgen changes. One showed typical cells in the sputum and two others on lung puncture. The one female patient had somewhat atypical roentgen changes but typical cells were obtained on lung puncture.

Six roentgenograms; 2 photomicrographs.

BERNARD S. KALAYJIAN, M.D.
Detroit, Mich.

Arteriovenous Aneurysm of the Lung. H. E. Pugsley and R. M. Janes. Dis. of Chest **20**: 177–185, August 1951.

An arteriovenous aneurysm of the lung is a vascular cavity, incompletely divided by septa, in direct communication with one or two dilated branches of the pulmonary artery and vein. It permits venous blood to be shunted from the pulmonary artery to the pulmonary vein without being oxygenated, giving rise to secondary polycythemia, cyanosis, clubbing of the fingers, and dyspnea on effort.

The authors give the case history of a 34-year-old woman with dyspnea, cyanosis, and clubbed fingers. Physical examination revealed a loud systolic murmur and thrill over the lower left chest anteriorly. On the right side, a distant bruit was heard. A roentgenogram revealed an irregular area of density adjacent to the left side of the cardiac silhouette, measuring approximately 3 cm. in diameter. On the right side, a smaller shadow was present near the cardiophrenic angle. These shadows became larger when intrathoracic pressure was decreased, and smaller when it was increased. Laminagraphic examination localized the density on the left side in the lingula, and the one on the right side in the middle lobe. Filling with contrast substance on angiocardiography established the diagnosis of arteriovenous aneurysms. The aneurysms were excised, with complete disappearance of all symptoms.

The authors summarize in a table 40 cases (including their own) reported in the literature.

Five roentgenograms. HENRY K. TAYLOR, M.D.
New York, N. Y.

Mucoid Impaction of the Bronchi. Robert R. Shaw. J. Thoracic Surg. **22**: 149–161, August 1951.

Abnormal mucous secretion and abnormal retention of mucus produce mucoid impaction of the bronchi. Non-surgical measures for relief include (1) chemotherapy, (2) expectorants, (3) bronchodilators. Roentgen therapy with large ports and small dosage may help. Surgical measures are used (1) if suppuration results, with destruction of pulmonary tissue, (2) if cystic bronchiectasis ensues, with repeated hemoptysis, (3) if diagnosis is uncertain and neoplasm must be ruled out.

Diagnosis by chest roentgenogram is not as yet conclusive, since the appearance is varied. Local accumulations of inspissated mucus occur in the branch bronchi of the second order distal to a bifurcation. The impaction grows, layer on layer, producing dilatation of the bronchi to many times the former diameter. Infection and destruction of cartilage and other tissues follow. This condition occurs in patients with an underlying chronic obstructive bronchitis or asthma.

The plugs of mucus range from 2.5 to 3.5 cm. in length and 0.9 to 2.3 cm. in diameter. On the film, they usually appear as V-shaped shadows near a lung hilus. Suppuration distal to the plug may produce a still larger shadow, sometimes totally obscuring the density due to the plug itself. Differentiation from neoplasm is difficult because of the sharply circumscribed dense shadow cast by the suppuration. An annular shadow with a fluid level can be produced if air is able to penetrate beyond the mucous plug. Serial films may disclose clearing of one segment and later involvement of the same or other segments.

This report is based upon 10 cases, in 8 of which confirmation was possible by examination of the surgical specimen.

Nineteen roentgenograms; 1 photograph.

DONALD DE F. BAUER, M.D.
St. Paul, Minn.

True Posterior Mediastinal Goiter. Nathan N. Crohn and Mathew W. Kobak. Am. J. Surg. **82**: 283–286, August 1951.

A case of true posterior mediastinal goiter is presented. In February 1949, a woman of 51 was hospitalized for treatment of a cervical goiter. Roentgen examination of the chest revealed a mediastinal tumor. A thyroidectomy was performed and, according to the surgeon, the mass in the neck was found to be separate from the mediastinal tumor. The histologic diagnosis was adenoma of the thyroid with involutional changes. In September 1940, radioactive iodine studies were performed. There was considerable accumulation of iodine in the neck but no uptake in the mediastinal mass could be detected. Roentgenographic studies, in January 1950, showed a widening of the mediastinum due to a rather homogeneous, well defined non-pulsating

tumor. The aortic knob was pushed downward laterally. The trachea was compressed anteriorly and the esophagus posteriorly. The mass did not move upward with swallowing.

A right thoracotomy was performed and the tumor was removed. Pathologic examination showed it to be a large (4 × 5 × 6 cm.) thyroid nodule with minimal secondary changes.

This case illustrates the facts that (1) radioactive iodine may not disclose the etiology of such a mass and that (2) a transthoracic exposure is necessary for the removal of such a deeply situated thyroid.

Three roentgenograms; 1 photograph; 1 photomicrograph.

Intrathoracic Meningocele. Gerardo Ottani. Ann. radiol. diag. **23**: 416–419, 1951. (In Italian)

In a patient presenting a large non-pulsating mass in the upper and posterior mediastinum, aspiration biopsy was attempted and clear spinal fluid was obtained, establishing the diagnosis of intrathoracic meningocele. The author stresses the necessity of keeping in mind this condition in the differential diagnosis of mediastinal masses.

Two roentgenograms. CESARE GIANTURCO, M.D.
Urbana, Ill.

Cor Pulmonale in Infancy and Early Childhood. Report on 34 Patients, with Special Reference to the Occurrence of Pulmonary Heart Disease in Cystic Fibrosis of the Pancreas. Stephen W. Royce. Pediatrics **8**: 255–274, August 1951.

A higher incidence of cor pulmonale exists in the pediatric age group, especially among infants, than was previously suspected. The majority of the cases are in children whose lung disease is associated with fibrocystic disease of the pancreas. Because with improved antibiotic therapy these children now tend to live longer, the chances of seeing this complication are increased. At Babies Hospital (New York), a review of a twenty-year autopsy series revealed 301 cases of right ventricular hypertrophy, including 29 cases of chronic cor pulmonale. In 25 of these, lung disease of the type associated with fibrocystic disease of the pancreas was present; in each of the other 4 the lung disease was of a different type (bronchiectasis, tuberculosis, interstitial pneumonia, diaphragmatic hernia, respectively). In addition, there were 2 examples of acute cor pulmonale, both due to obstruction of the pulmonary circulation by foreign bodies, and 3 cases of subacute cor pulmonale, also associated with fibrocystic lung disease. Clinical and pathological data are presented on these 34 patients, all but 2 of whom were under six years of age.

Approximately half the patients with cor pulmonale have terminal decompensation and die in severe right-sided cardiac failure. This may occur suddenly, only a few days after the first signs of chest disease, or may come on gradually after many years. The duration of disease bears an inverse ratio to the severity of the initial insult.

The diagnosis of cor pulmonale assumes greatest interest at the infant level. It is now clear that otherwise mysterious episodes of infant cardiac failure have been on the basis of pulmonary disease. In an older child with extensive pulmonary disease and clinical evidence of a failing heart, the presence of proved fibrocystic disease makes cor pulmonale a likely postmortem finding. An infant with the same combination of signs presents a more difficult problem in differential diagnosis. No single symptom or sign was diagnostic in the present series, and often the onset of cardiac disability could be postulated only in retrospect.

Roentgenographic examination gives a paradoxic finding: the strained, hypertrophied heart appears to decrease in size as the lung disease progresses. In the adult, roentgenography is of positive value in showing prominence of the right ventricle, occasionally a dilated pulmonary conus, and measurable cardiac enlargement, but similar fine localization of damage is not feasible in pediatric cases. Conversely, it has been found that as the lungs increase in size, the heart tends to shrink in its relative proportions. A common report on the chests of these emphysematous children is that the cardiac shadow appears "small" or "relatively small." Some writers feel that the heart is more efficient in the early stages of emphysema, that its muscle tone is improved by working against the increased pressure, and the heart itself is spared by the limited pulmonary capacity. It has also been pointed out that cardiac hypertrophy (without dilatation) contributes relatively little to the cardiac shadow because the muscle is thickened only a few millimeters at most.

Perhaps the most important factors producing the small heart are those of cardiac compression and, to a lesser extent, cardiac distortion, both of which result from the emphysema. The increased pressure of emphysema exerts its effect along three different lines: (1) The diaphragm is pushed down by the emphysematous lungs. This tends to elongate the heart, with a decrease in the cardiothoracic ratio. (2) The cardiothoracic ratio is further decreased by the abnormol widening of the chest. (3) In emphysema there is an increase in both the venous pressure and in the intrathoracic pulmonary pressure, but the latter is more pronounced. The shift in balance between the air and fluid pressures is of primary importance. That this pressure imbalance will decrease the size of the heart has been demonstrated by the Valsalva experiment.

Five roentgenograms; 1 drawing; 2 charts; 3 tables.

Localized Interlobar Pleural Effusion in Heart Failure. Daniel J. Feldman. J. A. M. A. **146**: 1408–1410, Aug. 11, 1951.

Having once appeared as a feature of heart failure, a localized interlobar effusion tends to recur with subsequent episodes. It is most commonly seen between the upper and middle lobes of the right lung, but occasionally may appear on the left side. The roentgenographic appearance is generally that of an ovoid or elliptical shadow, but associated abnormalities of the lung or hilus can distort the symmetry of the shadow and make recognition difficult.

A single case is reported in which the interlobar effusion resembled a neoplasm. The localized nature of the effusion may be explained by the presence of a deep congenital indentation in the region of the interlobar fissure, which tends to hold the transudate.

Three roentgenograms. C. R. PERRYMAN, M.D.
Pittsburgh, Penna.

Interesting Cardiovascular Abnormalities Discovered on Mass Chest Roentgen Surveys. Hyman Alexander. Dis. of Chest **20**: 167–176, August 1951.

The reported incidence of cardiovascular abnormali-

ties detected on mass surveys varies from 2 to 6 per cent. In many cases thus discovered, the patient was unaware of a cardiac lesion. The author presents 10 cases illustrating the following conditions discovered on mass survey: (1) right aortic arch and hypertensive cardiovascular disease; (2) coarctation of the aorta and rheumatic heart disease; (3) huge aneurysm of aorta; (4) aneurysmal dilatation of aorta with calcification; (5) anomalous pulmonary vein; (6) dextrocardia with situs inversus; (7) congenital heart disease; (8) rheumatic heart disease; (9) aneurysm of left ventricle; (10) calcification of pericardium.

Sixteen roentgenograms. HENRY K. TAYLOR, M.D.
New York, N.Y.

Diagnosis of Aortic Septal Defect by Retrograde Aortography. Report of a Case. Benjamin M. Gasul, Egbert H. Fell, and Raul Casas. Circulation **4**: 251–254, August 1951.

Aortic septal defect is one of the rarer congenital anomalies, consisting in a communication between the ascending aorta and the main pulmonary artery above the semilunar valves. Clinically the findings resemble those in patent ductus arteriosus but, unlike the latter anomaly, the communication is not usually accessible for surgery. The authors knew of only one case successfully operated upon (Gross: Personal communication).

The subject of the present report was a child of three and a half years with clinical and angiocardiographic findings consistent with a patent ductus. It was felt, however, that the presence of a systolic and diastolic murmur due to a patent ductus was unusual in so young a child, and this, along with previous experience in a case mistakenly diagnosed and explored, suggested the possibility of an aortic septal defect. Accordingly, aortography was done, 5 c.c. of 70 per cent Diodrast being injected into the left axillary artery. The pulmonary artery was seen to be filling from the ascending aorta with no sign of a patent ductus.

This is said to be the first case in which a diagnosis of aortic septal defect has been made clinically. Operation was not attempted.

Three roentgenograms; 1 drawing; 1 electrocardiogram. ZAC F. ENDRESS, M.D.
Pontiac, Mich.

Changes in Configuration of the Ventricular Chambers During the Cardiac Cycle. Robert F. Rushmer and Dean K. Crystal. Circulation **4**: 211–218, August 1951.

Mechanics of Ventricular Contraction. A Cinefluorographic Study. Robert F. Rushmer and Nathan Thal. Circulation **4**: 219–228, August 1951.

A wealth of detail as to the anatomy and physiology of the cardiovascular system of the dog is presented in the two papers listed above. The studies were made by means of angiocardiography with Diodrast, with cinefluorographic recordings for 10 and 14 seconds, at a rate of 15 or 30 frames per second. In 3 animals, Lipiodol was injected in lieu of Diodrast.

The films were studied by ordinary projection, by individual frame projection, tracing of projected images, photographic enlargement, and by "counter-offset" printing, which tends to reduce to a neutral background everything in the picture except that which changes from one frame to the next (the shadow of the dye).

It was found that filling of the ventricles occurred more rapidly than emptying. No changes in area of the two ventricles were seen following the rapid filling phase, even with the contraction of the atria. The left ventricle resembles a cylinder with a cone at one end. In systole it is reduced in diameter but only slightly in length. The right ventricle has a semilunar shape in cross section and it is the blood in the lateral folds that is evacuated mostly in systole. No rotation of the heart was seen in either systole or diastole.

Systolic emptying was surprisingly incomplete, some 35 per cent of the diastolic volume remaining at the end of systole. As would be expected, the ventricular walls were found to increase in thickness in systole. Architecturally the right ventricle can vary its stroke volume greatly as long as there is no increased pressure in its outflow tract. It is definitely vulnerable to an increase in pressure in the pulmonary arterial tree. The left ventricle, on the other hand, is well suited as a pump to act against high pressure in the peripheral arteries.

Eight series of cinefluorograms; 3 drawings; 2 graphs. ZAC F. ENDRESS, M.D.
Pontiac, Mich.

THE DIGESTIVE SYSTEM

Benign Lesions of the Stomach. Harry Nushan, Benjamin Miller, and William A. Read. Virginia M Monthly **78**: 404–411, August 1951.

The stomach reacts to insults in one of several ways, depending on the amount of injury and individual differences. The same type of lesion may be produced by a variety of causes. The authors' classification of benign lesions is as follows:

I. Congenital
II. Inflammatory, due to a specific organism
  A. Acute phlegmonous gastritis, due to pyogenic organisms
  B. Chronic gastritis, due to tuberculosis, syphilis, or actinomycosis
III. Non-specific, non-inflammatory
  A. Acute gastritis
  B. Chronic hypertrophic gastritis
    1. General
    2. Local: redundancy of mucosa with prolapse into the pyloric canal or esophagus
  C. Chronic atrophic gastritis
  D. Benign hypertrophic pyloric stenosis
  E. Granulomas
IV. Lesions due to physical agents
  A. Irritants (including foods, drugs, ingested bacteria and toxins, ingested coal dust and silicates)
  B. Corrosives
  C. Irradiation
  D. Trauma
  E. Foreign bodies, bezoars, gallstones
  F. Postoperative stomach (following anastomotic operations and vagotomy)
V. Peptic ulcer
VI. Benign neoplasms
VII. Manifestations of systemic disease
  A. Arteriosclerosis
  B. Pernicious anemia; sprue; cord degeneration; iron deficiency anemia

C. Polyarteritis nodosa
D. Telangiectasia
E. Lead poisoning; other organic and inorganic poisons
F. Sarcoidosis
G. Allergy
H. Avitaminosis
I. Stomach in skin diseases
J. Many acute infections, as typhoid fever, influenza, etc.
K. Uremia

VIII. Neurogenic and reflex

IX. Miscellaneous (including varices; hernia; acquired diverticula; volvulus; intussusception; calcification; pressure from extrinsic tumors)

The most common lesion of the stomach is said to be gastritis. It may be the cause of bleeding and yet may produce no abnormal findings on x-ray examination.

The two principal lesions calling for roentgenologic differentiation are peptic ulcer and cancer. Gastric ulcers usually occur on the lesser curvature, with a deep, spastic incisura opposite the ulcer niche. A similar appearance may be caused by arteriosclerosis, syphilis, tuberculosis, polyarteritis nodosa, Hodgkin's disease, chronic hypertrophic gastritis, and carcinoma.

To illustrate points of diagnosis the authors describe 8 cases.

In *Case I* a defect in the mid-portion of the duodenal bulb, demonstrated roentgenologically, was regarded as consistent with a duodenal ulcer or perioduodenal adhesions. Autopsy six months later revealed a prepyloric ulcer on the greater curvature of the stomach which microscopically was shown to be due to Hodgkin's disease. The duodenum showed no ulceration.

In *Case II* there was a history of indigestion for some years and of recent vomiting of large clots of blood. Roentgen examination revealed a deformity of the prepyloric region. Gastric analysis showed a total acidity of 70°, with 35° free acid. A subtotal gastrectomy was done, but the patient did not improve. At autopsy, six months after operation, typical lesions of polyarteritis nodosa were found in the spleen and pancreas. A review of the slides of the resected stomach showed the same findings.

The *third patient* showed a niche on the pars media, measuring 5 cm. in diameter, with no spasticity of the greater curvature side. Operation revealed a large carcinoma of the cardia that had invaded the pancreas and liver.

In *Case IV* a gastro-intestinal series showed a filling defect on the greater curvature side of the pylorus which was suggestive of a new growth. After several episodes of pain and vomiting, the patient was operated upon. A thickening of the wall of the pylorus was found, and no further surgery was done. Autopsy following death from cerebral hemorrhage a month later showed the thickening of the stomach to be due to a fecalith in the soft tissues which apparently came from a ruptured diverticulum of the colon years before.

The *fifth patient* showed an irregularity of the antrum and a shelf-like deformity of the greater curvature side of the stomach suggesting a malignant growth and hypertrophic gastritis. At operation the deformity was found to be due to redundant gastric mucosa with herniation into the duodenum. Microscopic sections revealed a chronic gastritis.

In *Case VI* a spherical defect was demonstrable in the posterior gastric wall, measuring 4 cm. in diameter. At operation it proved to be due to a neurofibroma.

In *Case VII* a gastro-intestinal series showed a decrease in peristaltic waves, narrowing of the pylorus, and upward displacement of the antrum. This part appeared rigid fluoroscopically. A diagnosis of a new growth was made and a subtotal gastrectomy was done, but gross and microscopic examination of the specimen showed no lesion of significance. Death occurred a week later from pulmonary edema. No evidence of carcinoma could be found.

The *eighth patient* had a tube-like deformity of the lower portion of the stomach, and a six-hour film showed a complete retention of barium. The Wassermann reaction was strongly positive, and there was a history of treatment for syphilis. A subtotal gastrectomy was done. The pylorus was narrowed and there was a prepyloric ulcer involving the stomach. The microscopic findings were compatible with syphilitic ulcer.

It is urged that before a definite diagnosis of gastric disease is made on the basis of roentgenographic findings, an adequate history be taken, a good physical examination be performed, and the case be evaluated as a whole. Laboratory examinations of various sorts and gastroscopic examination should then be done to clarify the diagnosis further. Even then, the exact diagnosis may have to await the result of treatment and serial films.

Eight roentgenograms. JOSEPH T. DANZER, M.D.
Oil City, Penna.

Giant Hypertrophic Gastritis: Its Surgical and Pathologic Significance. Louis T. Palumbo, George M. Rugtiv, and Kenneth R. Cross. Ann. Surg. **134:** 259–267, August 1951.

The authors describe in some detail the clinical, roentgen, gastroscopic, surgical, and pathological features in 1 case of simple hypertrophic gastritis and 3 cases of giant hypertrophic gastritis showing an apparent progression of changes.

The 4 cases were characterized by giant gastric rugae, cystic degeneration of the glandular epithelium, a preponderance of mucus-secreting cells, and inflammatory infiltration, with subsequent scarring in the submucosa. In 1 case of this small series, and in some cases reported by others, cancer was associated with the gastritis.

From a clinical point of view, giant hypertrophic gastritis is characterized by three types of symptomatology: (1) suggestive of peptic ulcer; (2) that of a progressive gastric neoplasm; (3) a variety of mild gastrointestinal disturbances. The majority of patients give a history of repeated gastric hemorrhages.

Radiographically, the stomach shows diffuse changes, usually more severe in the fundic and cardiac regions and along the curvatures. The mucosal folds are greatly thickened, indurated, and enlarged, tending to produce an exaggerated saw-tooth appearance. In some instances the mucosal markings become rigid, thus confusing the picture with cancer.

Gastroscopically, the findings are those of edematous, hypertrophied, inflamed mucosal folds. The mucosa may be granular and nodular and may be covered by an exudate.

Microscopically, the accentuated or polypoid rugae consist of elongated, tortuous glands. Within the epithelium, the mucous cells of the glands increase at

the expense of the chief and parietal cells, tending to approximate the appearance of intestinal glands. This is significant, since it has been claimed that almost all gastric cancers are derived from mucous cells. Another noteworthy feature is the cystic degeneration of the glands with disruption of the basement membrane, often with penetration into the muscularis mucosa. It is these mucosal changes that prompt the authors to consider this entity a possible precancerous state and to advocate total gastrectomy.

Three roentgenograms; 2 photographs; 6 photomicrographs.

I. R. BERGER, M.D.
VA Hospital, Chamblee, Ga.

Roentgenological Manifestations of Gastroduodenal Ulceration in the Newborn. Leslie L. Lemak. Am. J. Roentgenol. **66:** 191–199, August 1951.

Gastroduodenal ulceration in the newborn is not a new problem, having been reported as far back as 1829. While it is of infrequent occurrence, the author believes that it warrants further attention. The etiology has not been definitely determined. Five factors are discussed which may play a part: (1) circulatory disturbances, (2) high gastric acidity, (3) trauma, (4) sepsis, (5) burns and marasmus. The diagnosis is usually made postmortem. Roentgenologic recognition is infrequent.

Between 1940 and 1949, autopsy records of Children's Hospital of Michigan disclosed 18 cases of gastroduodenal ulceration in infants under two months of age. Nine of this number (50 per cent) exhibited brain damage on postmortem examination; 12 (66 per cent) were premature; 2 (11 per cent) had clinical evidence of infection; 8 (44 per cent) were vomiting on admission, and in 6 of these hematemesis developed; 6 (33 per cent) showed clinical evidence of brain damage. Seventeen of the group had gastric ulceration; only 1 had a duodenal ulcer.

Roentgen examination was done in 4 cases, and while it is limited in its usefulness, it may make some contribution to the diagnosis. It is quite improbable that direct visualization of an ulcer by contrast medium could be obtained in an infant, since the ulcers are very shallow and, being acute, are not associated with the scarring deformities of chronic peptic ulcer in the adult. An ulcer may give fairly certain evidence of its presence when it has perforated and gas is recognized as free in the abdominal cavity. If the amount of gas is large, it may be demonstrated on an abdominal roentgenogram made with the patient supine. For the detection of smaller amounts, an upright position is desirable, to permit recognition of gas beneath the diaphragm. Gastroduodenal ulceration may also give roentgen evidence of its presence by dysfunction of the pylorus.

Six cases are presented, with 9 roentgenograms.

NELSON E. KLAMM, M.D.
Cleveland City Hospital

Peptic Ulcer in Childhood. Report of Six Cases. James B. Gillespie and Helen E. Bliss. Arch. Pediat. **68:** 361–372, August 1951.

The authors review the literature and report 6 cases of peptic ulcer in children with an age range of two to nine years. In each instance the diagnosis was made after adequate roentgenologic study. Five cases were duodenal in origin and there was one gastric ulcer. In larger series reported in children, the ratio of duodenal to gastric ulcer is at least three to one.

In at least 2 of the authors' cases the actual lesion and symptoms persisted into young adult life. Generally, after ten years of age the peptic ulcer assumes the characteristic pattern by which it is identified in the adult.

Ulcers may occur in the stomach or duodenum of children of any age. The age of lowest incidence is between one and nine years; approximately 37 per cent of cases in children have been observed before one year of age.

The authors discuss the possible role of aureomycin in the initiation of an ulcer or aggravation of a previously existing ulcer. Such an incident occurred in one of the 6 cases reported.

The etiology of peptic ulcer is still a disputed point, but it is probable that certain factors which play a role in the adult may function in a similar way in children, though obviously such agents as alcohol and tobacco are of no significance in childhood.

Three roentgenograms.

ROBERT H. LEAMING, M.D.
Memorial Center, N. Y.

Effect of Combined Sympathectomy and Vagectomy on the Gastro-intestinal Tract. John R. Bingham, Franz J. Ingelfinger, and Reginald H. Smithwick. J. A. M. A. **146:** 1406–1408, Aug. 11, 1951.

Studies were made of 6 patients before and after combined sympathectomy and vagectomy. Clinical observations were made in 5 of the 6 cases. Appetite was unchanged in 3 patients and increased in 2. Following surgery, nausea and vomiting were experienced by all 5 patients on the rare occasions when they were exposed to such spontaneous stimuli as usually induced these symptoms. "Gas" or "bloating" sensations noted by 2 patients prior to operation persisted postoperatively. Heartburn disappeared after operation in 1 of 2 patients who complained of this symptom preoperatively. The bowel habits of 3 patients were unchanged. Two patients suffered from occasional bouts of diarrhea at the time of the follow-up six months after vagectomy. The gastrocolic reflex persisted in 2 patients after operation.

Since appetite and hunger are in general unaffected, the theory that vigorous gastric peristalsis produces hunger must presuppose afferent pathways other than those along the splanchnic or vagus nerves. Heartburn may be expected to persist, since the esophageal innervation remains intact.

On the basis of radiologic studies the patients are divided into two groups. The first, comprising 4 patients undergoing simultaneous sympathectomy and vagectomy, exhibited delayed initial gastric emptying, and both the degree and duration of gastric peristalsis appeared decreased. The five-hour gastric retentions were 15, 30, 80 and 80 per cent, respectively. The rate of small intestinal motility appeared decreased in 3 patients and unaltered in the fourth. One of the patients was re-examined one year later. Gastric emptying and peristalsis had improved and the five-hour retention had diminished from 80 to 10 per cent.

The second group, consisting of the 2 patients in whom sympathectomy preceded vagectomy by intervals of one and three years, respectively, did not manifest initially delayed gastric emptying or decreased gastric peristalsis. There was, however, a 25 per cent five-hour gastric retention. Small intestinal motility was unchanged.

Radiological studies show that sympathectomy has

no apparent effect on gastric motility. The marked gastric hypomotility in the 4 patients in the first group is therefore considered to be the result of vagal interruption. Vagal section seems to produce the same changes whether the sympathetics are interrupted simultaneously or not. In spite of the radiologic evidence of gastric retention noted in these 4 patients, clinical signs of gastric stasis were absent. This is in contrast to the situation after vagus section alone.

Three roentgenograms. C. R. PERRYMAN, M.D.
Pittsburgh, Penna.

Surgical Error of Gastroileostomy. Report of Six Cases. Arthur G. Michels, Charles H. Brown, and George Crile, Jr. Am. J. Surg. **82**: 191–197, August 1951.

Gastro-ileostomy is a relatively uncommon surgical error. However, with the increasing employment of vagotomy and gastro-enterostomy in the treatment of duodenal ulcer, more gastro-ileostomies are likely to occur. This error can and should be avoided by positive identification of the ligament of Treitz when a gastro-enterostomy is performed.

The diagnosis of gastro-ileostomy may be suggested by a history of severe weight loss, pain, diarrhea with the passage of undigested food in the stool, vomiting, and, in about one-fifth of the cases, fecal vomiting, hemorrhage, and signs of an ileac or marginal ulcer. Symptoms may appear immediately after the operation or may be delayed for years, particularly if the gastro-ileal stoma is not functioning.

In most instances the roentgen examination is diagnostic, revealing a direct communication from the stomach to the right colon. Brown, *et al.* (Gastroenterology **8**: 71, 1947. Abst. in Radiology **49**: 747, 1947) stresses the importance of serial films to demonstrate gastric refilling after part of the barium has left the stomach. The barium meal can pass through a patent pylorus into the duodenum and hence through the jejunum and upper ileum and once again enter the stomach. A three-hour film may show the stomach empty while a five-hour film may show considerable barium.

Six cases of gastro-ileostomy are presented in some detail. All of the patients gained weight following surgery, and in none has there been a recurrence of symptoms.

Five roentgenograms.

Eosinophilic Granuloma of the Stomach and Small Intestine. Robert J. Booher and Roald N. Grant. Surgery **30**: 388–397, August 1951.

The authors have collected 11 cases of eosinophilic granuloma of the upper gastro-intestinal tract from the literature. These cases are reviewed and discussed, with particular emphasis on symptomatology, x-ray findings, eosinophil count, allergic history, and gross anatomy. The most common manifestation of the disease is the formation of a poorly circumscribed submucosal nodule which tends to become pedunculated and polypoid, and which occurs most frequently in the pyloric antrum.

It is suggested that the blood eosinophilia found in those cases presenting the greatest gross pathologic change, together with the local gastro-intestinal tissue eosinophilia, may indicate an allergenic background not apparent in the localized or solitary form of the disease.

A case of solitary prolapsing submucosal eosinophilic granuloma is presented.

Two roentgenograms; 2 photomicrographs; 1 photograph; 1 table. R. W. DICKENHORST, M.D.
Shreveport (La.) Charity Hospital

Traumatic Retroperitoneal Rupture of the Duodenum. Robert B. Newell, George R. Rosenbaum, and Noland M. Canter, Jr. Ann. Surg. **134**: 277–278, August 1951.

A 20-year-old man was injured in an auto accident. Initially, he had no abdominal symptoms, and films of the abdomen made two hours following the accident were considered negative. Some ten hours later, epigastric pain developed and signs pointing to intra-abdominal trauma supervened. Free air could be demonstrated in the retroperitoneal spaces about the kidneys and the psoas bundles. No free intraperitoneal air was seen. On the basis of these findings a diagnosis of retroperitoneal perforation of the duodenum was made, and this was confirmed at operation. A rent 3.0 cm. in length was found on the posterior surface of the second part of the duodenum.

One roentgenogram. I. R. BERGER, M.D.
VA Hospital, Chamblee, Ga.

Diagnosis of Colonic Lesions. Martin L. Tracey. Am. Practitioner **2**: 673–679, August 1951.

This is a general discussion of disease of the colon presented before the American College of Physicians (April 1950). A complete examination includes digital, instrumental, and radiographic procedures, and the possibilities and limitations of each are set forth. Many more carcinomas and polyps can be discovered by palpation or proctosigmoidoscopy than by x-ray examination, since their frequency of occurrence within reach of these methods is much higher than in the more proximal part of the colon.

The author discusses the various phases of the x-ray examination (plain films, fluoroscopy, spot films, air contrast, etc.) with a view to showing the general practitioner what he may expect from such studies.

Seven roentgenograms; 1 drawing.
ZAC F. ENDRESS, M.D.
Pontiac, Mich.

Further Cases of Aberrant Pancreas. Lennart Kjellman. Acta radiol. **36**: 89–96, August 1951.

Four cases are reported. Aberrant pancreatic tissue was found at operation in one case in the duodenum and in one case in the stomach. In both instances the history was that of pain of the peptic ulcer type associated with roentgen findings consistent with chronic duodenal ulcer. In addition, in these 2 cases roentgen study showed a fine thread-like streak of barium in the area of duodenal deformity. The surgical specimens disclosed pancreatic tissue containing small ducts of a size to correspond with the thread-like barium streaks on the films.

Similar roentgen findings were noted in the other 2 cases, not proved surgically. In one of these the duodenum presented a small deformity caused by a rounded indentation in the mucous membrane with a central funnel-shaped excavation from which ran a small canal 1 cm. in length. The other was characterized by repeated hematemesis and vomiting. The roentgen find-

ings within the antrum of the stomach were similar to those described in the preceding case.

It is generally believed that the nearest we may come to a diagnosis of aberrant pancreatic tissue is the diagnosis of a polyp. The author feels, however, that roentgen demonstration of filling defects which appear benign and which contain contrast-filled canals of variable width give such an unequivocal picture that they permit a diagnosis of aberrant pancreatic tissue.

Fifteen roentgenograms; 4 photomicrographs.

I. R. BERGER, M.D.
VA Hospital, Chamblee, Ga.

Sarcoidosis: Report of a Case Simulating Gall Bladder Disease Treated with Aureomycin. William H. Mast. Ohio State M. J. **47:** 713–716, August 1951.

In the case presented here, extensive involvement by sarcoid disease of lymph nodes in the upper abdomen produced a rather typical clinical picture of cholecystitis and a small filling defect in the cholecystogram. At surgery some of the nodes were removed to free the gallbladder; the organ itself seemed normal. X-ray examination of the chest following surgery showed extensive nodular lesions in both lungs, fanning out from masses of enlarged hilar nodes, although a film made six months earlier had been normal.

Treatment was started with aureomycin on the suggestion that sarcoidosis may be a virus disease (Longcope and Pierson: Bull. Johns Hopkins Hosp. **60:** 223, 1937). Surprisingly, symptoms abated rapidly, and eleven months after surgery the chest film was again negative.

Four roentgenograms; 2 photomicrographs.

ZAC F. ENDRESS, M.D.
Pontiac, Mich.

Spontaneous Internal Biliary Fistula. A Case of Cholecystocolic Fistula. Arthur G. Michels and Stanley O. Hoerr. Cleveland Clin. Quart. **18:** 184–189, July 1951.

The authors report a case of cholecystocolic fistula in a 73-year-old woman, diagnosed preoperatively and confirmed at operation. A clinical diagnosis of chronic cholecystitis had been made twenty-three years previously, but subsequent cholecystograms had been normal until one year prior to admission, when gallstones were demonstrated. The patient complained of epigastric pain, fever, and diarrhea, with numerous foul green stools. She was not jaundiced, nor was there any history of acholic stools or dark urine. The liver was enlarged and tender.

Barium enema examination revealed a fistula between the biliary tree and the hepatic flexure. A large calculus was noted in the dilated common duct. This was confirmed at operation. The gallbladder containing 5 faceted stones was removed, the fistulous tract, which communicated with the fundus of the gallbladder, was divided, and two stones were removed from the common duct. The postoperative course was uneventful.

Spontaneous internal biliary fistulae most commonly involve the gastro-intestinal tract. An infected gallbladder may adhere to adjacent structures. If the cystic or common duct becomes obstructed, parts of the biliary tree may become even more densely adherent, necrosis may occur, and stones may pass into the adherent viscus through the fistula. A ruptured gallbladder may cause a pericholecystic abscess with necrosis of the intestinal wall and fistula formation. Malignant neoplasm or peptic ulcer may also cause perforation and fistula.

It has been estimated that 4 per cent of all patients requiring surgery for biliary disease have internal biliary fistulae. They occur most frequently between the gallbladder and duodenum; next between the bile ducts and duodenum.

Biliary fistula can be positively diagnosed when barium administered by mouth or enema outlines the biliary tree. Air in the biliary tract is almost always diagnostic of internal biliary fistula.

Four roentgenograms.

BERTRAM LEVIN, M.D.
Chicago, Ill.

Roentgen Demonstration of the Deposition of Colloidal Thorium Dioxide (Thorotrast) in the Gallbladder Wall with Report of a Case. Everett L. Pirkey, Richard C. Taylor, Aura J. Miller, Frank Denman, and Herbert D. Kerman. Am. J. Roentgenol. **66:** 208–214, August 1951.

A review of the literature disclosed no previous case of visualization of the gallbladder wall following injection of Thorotrast. This radioactive contrast material is known to be deposited in the recticulo-endothelial system of the liver, spleen, lymph nodes, and bone.

The present report concerns a fifty-five-year-old white male with constant right epigastric pain beginning five days prior to hospital admission. An ill-defined tender mass was palpated in the upper right quadrant. Twice repeated cholecystograms were non-revealing. Twelve hours and thirty minutes following administration of colloidal thorium dioxide, a roentgenogram showed a thin "U"-shaped density adjacent to the right lobe of the liver. Approximately three weeks later, this shadow was still present but smaller. Cholecystectomy was performed and the gallbladder was found large, tense, slightly edematous, and filled with stones.

Microscopic slides showed focal ulceration of the mucosa. The lamina propria was infiltrated with lymphocytes, plasma cells, and a few eosinophils with occasional neutrophils. Focal hemorrhage was present in the lamina propria and to a lesser degree in the muscularis and subserosa. In the interstitial connective tissue between muscle bundles, and to a lesser extent peripheral to these, were masses of macrophages containing within the cytoplasm grayish-purple to grayish-brown coarse granules. Arterioles and venous branches showed subendothelial proliferation of young fibrous connective tissue. Sections stained by potassium ferrocyanide and hydrochloric acid for hemosiderin revealed granules corresponding to those described above. Radioautographs showed alpha tracks closely associated with the macrophages.

It is suggested that following an episode of interstitial hemorrhage macrophages appeared in the gallbladder wall and that these acted as a part of the reticulo-endothelial system, taking up circulating particles of the injected thorium.

Five roentgenograms; 4 photomicrographs; 1 photograph.

MILTON SEGAL, M.D.
Cleveland City Hospital

Saint's Triad: Hiatus Hernia, Diverticulosis Coli, and Gall Stones. Eddy D. Palmer. Am. J. Digest Dis. **18:** 240–241, August 1951.

Saint's triad of hiatus hernia, diverticulosis coli, and

gallstones was first reported by Muller in 1948 (South African M. J. **22**: 376, 1948. Abst. in Radiology **52**: 760, 1949). The author reviewed 31 cases of hiatus hernia seen in the Gastrointestinal Clinic of the Walter Reed Hospital (Washington, D. C.) in which adequate examination had been made, roentgenologically or surgically, and found 5 cases in which there were associated gallstones and diverticulosis of the colon. These 5 cases are briefly reported.

THE MUSCULOSKELETAL SYSTEM

Fibrous Dysplasia—Fibro-Osteoma—Osteoma of the Facial Bones and the Skull. Andreas Hobæk. Acta radiol. **36**: 97–113, August 1951.

The histologic appearances of fibrous dysplasia, fibro-osteoma, and osteoma of the facial bones and skull are similar. They are characterized by connective tissue, more or less rich in collagen fibrils, containing a varying number of fibroblast- to osteoblast-like cells. Areas of osteoid tissue, giant cells, and trabeculae of new bone may be seen. The immature bone rarely develops into a functionally normal, architecturally arranged structure.

In spite of this similarity of histologic structure, the roentgen findings seen in the 52 cases of the author's series showed widely varying patterns. Surgery was performed in 16 of the 52 patients. An analysis of the series is presented in tabular form (I).

I. FIBROUS DYSPLASIA; FIBRO-OSTEOMA; OSTEOMA OF FACIAL BONES AND SKULL (HOBÆK)

Situation	Number of Cases	Sex		Age	No. of Cases Operated Upon	Histologic Diagnosis
		F.	M.			
Maxillae and zygomatic bones	12	7	5	11–43	5	Fibro-osteoma.....3 Osteoma.....1 Giant-cell.....1
Mandible	4	1	3	21–27	3	Fibro-osteoma.....3
Ethmoid bones	5	2	3	15–57	3	Osteoma.....2 Osteoma-fibroma..1
Frontal sinuses	21	8	13	18–39	4	Osteoma.....4
Basis cranii	3	2	1	15–62	0	
Cranial vault	7	4	3	20–45	1	Osteoma.....1

II. FIBRO-OSTEOMA; FIBROUS DYSPLASIA; OSTEOMA OF FACIAL BONES AND SKULL (HOBÆK)

Type of Lesion	Borders	Sclerosis	Principal Situation	Age
Fibro-osteoma	Most often relatively sharp	Irregular. Less marked to average	Maxillae, antra Highmori, and mandible	At puberty or later
Osteoma	Sharp Extra-tumoral translucent zone. Lobular shape	Usually marked	Cranial vault Paranasal sinuses	At puberty or later
Fibrous dysplasia	Definitely unsharp	Homogeneous Less marked to marked	Basis cranii (frontal and sphenoid bones) Maxilla and zygomatic bones	Usually before puberty

Fibro-osteoma (ossifying fibroma, osteofibroma, hyperostoses) is most frequently seen in the upper jaw and the antrum of Highmore. The lesion is usually well defined and dates back to childhood or puberty. The shape is round to oval. There is usually sclerosis, rarely homogeneous in character and sometimes presenting the appearance of granulation. When the affection of the maxilla spreads to the zygoma or to the orbits, the process usually has less well defined borders and the sclerosis is more homogeneous; it may be classified as fibrous dysplasia. Osteomas are usually sharply defined and densely sclerotic. The characteristics of the three types are well expressed in the accompanying table (II).

Twenty-one roentgenograms; 7 photomicrographs.

I. R. BERGER, M.D.
VA Hospital, Chamblee, Ga.

Polyostotic Fibrous Dysplasia of Bone. Andreas Hobæk. Acta radiol. **36**: 145–154, August 1951.

The cause and nature of polyostotic fibrous dysplasia of bone remain unknown. One author postulates a lesion of the central nervous system; another is of the opinion that disturbances in metabolism of the endocrine glands is the etiologic factor, and still others suggest congenital anomalies of the mesenchyme. In the one complete autopsy study of a case of polyostotic fibrous dysplasia (Sternberg and Joseph: Am. J. Dis. Child. **63**: 748, 1942. Abst. in Radiology **39**: 501, 1942) hypertrophy of the basophil apparatus of the pituitary was found, with formation of microscopic adenomas. In this case, there was atrophy of the adrenal cortex and a relative hypertrophy of adrenal medulla tissue. No central nervous system lesions were demonstrated.

Seven cases were observed at Oslo University Hospital in the course of a decade: 4 in females and 3 in males. None of the cases showed precocious puberty or anomalous pigmentation of the skin.

The disease commences in childhood. The site of predilection is the long bones, most frequently the femur

and the tibia. The lesions may affect one or two limbs; unilateral bimelic distribution is the most usual type. The ribs, skull, and pelvic bones are next in order of involvement.

In the long bones, the dysplastic process is localized to the metaphyses and the diaphyses. The epiphyses are attacked only after closure of epiphyseal growth lines. The process begins centrally and gradually hollows out the cortex from within. This hollowing out process is distinctive. The earliest changes may appear as small cysts, but as the lesions progress in extent and size, the translucent regions present a diffuse veiling, due to formation of numerous fine bone spicules in the tissues. The spicules consist of immature, primitive osseous tissue without functional organization. This produces the "ground-glass" appearance which is a second important diagnostic criterion.

Points of differentiation between polyostotic fibrous dysplasia, lipoid granulomatosis, and neurofibromatosis are discussed.

Twelve roentgenograms; 2 photomicrographs; 7 drawings. I. R. BERGER, M.D.
VA Hospital, Chamblee, Ga.

An Irregular, Familial Chondro-Osseous Defect, with Suggestions Concerning the Nomenclature of the Generalised Osseous Dystrophies. W. P. U. Jackson. J. Bone & Joint Surg. **33-B:** 420–429, August 1951.

From Cape Town, South Africa, the author reports some interesting observations on three elderly dwarf siblings from a large and otherwise normal family. On roentgen examination (of the two most severely affected), the shoulders, elbows, hips, and knees showed great irregularity of joint surface and surrounding bone, with local hypertrophy and utterly abnormal shapes, diminution of joint space, osteoarthritis, and some rarefaction. The radii were bowed, the forearms short, and the phalanges short and stumpy. The spines showed gross kyphoscoliosis. All three patients had severe clubfoot. The skulls were normal.

The deformities observed in these patients represent an irregular chondro-osseous dystrophy with features of similarity to at least four recognized syndromes, namely achondroplasia, Morquio-Brailsford osteochondrodystrophy, dysplasia epiphysialis multiplex, and diaphysial aclasia. For these reasons a simplification of classification and nomenclature of generalized developmental osseous dystrophy seems highly desirable, and this the author has attempted. A review of his proposed classification is worth while, though it is not intended as complete or final. It is, however, a definite step toward the simplification of these generalized developmental bony syndromes, at least to a practical and easily understood basis.

Two roentgenograms; 7 photographs; 1 table.
ROBERT H. LEAMING, M.D.
Memorial Center, N.Y.

Hereditary Osteopoikilosis Observed in Three Generations. Václav Šváb, and Václav Bek. Acta radiol. et cancerol. bohemoslovenica **5:** 110–119, 1951. (In French)

Osteopoikilosis was observed in three generations of the same family, and the authors believe it may be of dominant inheritance. Members of the same generation may be affected in various forms. Thus, one member of the third generation in the present series showed scattered round lesions, while in another a "striped" form was seen. The bone changes are often accompanied by dermatofibrosis lenticularis disseminata, a harmless condition of the skin which may develop or become manifest at an advanced age.

Four roentgenograms. CHARLES M. NICE, M.D.
University of Minnesota

Maffucci's Syndrome: with a Report of a Case. Howard Halper and Leigh Wedlick. M. J. Australia **1:** 936–939, June 30, 1951.

The authors report the first case of Maffucci's syndrome (dyschondroplasia with hemangiomata) in the Australian literature, which they believe to be the twenty-fourth case in the world literature. They present the clinical and radiological features of the condition, and briefly discuss the differential diagnosis.

Five roentgenograms; 4 photographs.
SIDNEY KING, M.D.
Hancock, Mich.

Scleroderma and Melorheostosis. Report of a Case. N. M. Thompson, C. E. L. Allen, G. S. Andrews, and F. N. Gillwald. J. Bone & Joint Surg. **33-B:** 430–433, August 1951.

The author reports on the clinical and radiographic features as well as the treatment of a single case of scleroderma and melorheostosis in a ten-year-old Indian girl. She had a deformity of the right leg, present since birth, with an associated limp and pain in the right knee. A linear scleroderma overlay and involved the right sartorius tibialis anterior and abductor hallucis muscles. It was considered that the abnormal fibrous tissue was responsible for the deformity and possibly for growth retardation of the medial epiphyseal plates.

Radiographically there were irregular densities involving the distal femoral epiphysis, both tibial epiphyses, and the patella, presenting a coarse lacework appearance. The medial aspect of the right femur and tibia showed a characteristic "flow" of dense bone. There were also changes of an osteopoikilic nature in the bones of the feet and wrists. There was no involvement of the skull, spine, or ribs.

Operation revealed that the right sartorious muscle was missing, being replaced by thick, yellow, fibro-fatty tissue. The child died four days postoperatively from fat embolism. Unfortunately consent for autopsy was refused.

Four roentgenograms; 2 photographs.
ROBERT H. LEAMING, M.D.
Memorial Center, N.Y.

Diabetic Arthropathy. Folke Knutsson. Acta radiol. **36:** 114–120, August 1951.

In diabetics between the ages of thirty and seventy who have had the disease for a number of years, changes in the ankle joints and tarsi may develop, having the characteristics of neuropathic arthropathy. These changes manifest themselves in the form of swelling around the ankle joint and tarsus, which swelling may attain considerable proportions but is devoid of inflammatory features. The patients walk without pain. There is a discrepancy between the objective findings and the subjective symptoms.

Roentgen examination of the affected joints shows destruction of the epiphyses and erosion of the joint surfaces. Loose fragments of bone may be found in the

adjacent soft tissues. Diffusely scattered bone sand may result from the disintegration of the osseous structures. There is no regional loss of calcium and decalcification is found only in small localized areas. Initially, articular cartilages resist destruction, but as the arthropathy progresses the cartilage is gradually destroyed.

The appearance of the articular deformity and absence of bone pain lend support to a neuropathic basis.

The author briefly presents four illustrative cases.

Eleven roentgenograms; 3 photographs.

I. R. BERGER, M.D.
VA Hospital, Chamblee, Ga.

Alkaptonuric Arthritis. Report of a Case. Sidney Sacks. J. Bone & Joint Surg. **33-B:** 407–414, August 1951.

The author reports the first case of alkaptonuric arthritis from Africa, presenting the characteristic triad of alkaptonuria, ochronosis, and osteoarthritis.

Alkaptonuria, described as an "inborn error of metabolism," is present from birth and persists throughout life. It is one of the best examples of a metabolic defect behaving in accordance with the mendelian law, being inherited as a mendelian recessive character. In 50 per cent of the cases, discoloration of the urine by alkapton (homogentisic acid) is accompanied by ochronosis and osteoarthritis.

Ochronosis usually occurs with alkaptonuria but may also occur in association with melanuria or with external use of phenol (carboluria). The exact mode of deposition of these pigments in certain parts of the body is not clearly known.

Alkaptonuric arthritis radiographically resembles degenerative arthritis, but in addition there is a typical wafer-like calcification of the intervertebral disks and marginal osteophytes. In addition, destructive changes occur in the shoulder joints which resemble those found in neuropathic arthritis. Treatment is symptomatic.

Four roentgenograms; 4 illustrations in color.

ROBERT H. LEAMING, M.D.
Memorial Center, N. Y.

Radiodiagnosis of Osseous Modifications in Infantile Leukemias. V. Šváb and B. Horák. Acta radiol. et cancerol. bohemoslovenica **5:** 50–65, 1951. (In French)

Roentgen studies were carried out on 70 children, 65 with acute and 5 with chronic leukemia. Typical osteolytic and proliferative changes were found in more than 75 per cent of the cases. Evidence of eccentric osteolysis (irregular narrowing or erosion of the cortex on the side of the medullary canal) and signs of rarefaction (replacement of compact bone by spongiosa) were found in the metacarpals, the site of earliest discovery of leukemic bone changes. Similar changes are seen in erythroblastic anemia, but in the latter condition the peripheral periosteal changes are absent in the rest of the skeleton.

Fourteen roentgenograms.

CHARLES M. NICE, M.D.
University of Minnesota

Eosinophilic Granuloma with Multiple Osseous and Soft-Tissue Lesions in an Adult. Norman B. McCullough. Arch. Int. Med. **88:** 243–251, August 1951.

The author notes that only a few cases have been reported in which lesions histologically recognizable as eosinophilic granuloma have been found in both bones and soft tissues. He records another such case, in detail.

The patient was a 24-year-old white female. Lesions in the skull, mandible, cervical spine, and ribs were identified roentgenographically. Soft-tissue lesions were present in the gingiva, perineum, and within the anus. The rib lesion was excised, and the perineal and gingival ulcers were also biopsied, all showing typical eosinophilic granuloma. Diabetes insipidus developed suddenly during the course of the disease.

Repeated courses of vigorous x-ray therapy were finally effective in controlling the lesions. The diabetes insipidus became less severe after irradiation of the pituitary area. No new lesions had developed during the eighteen months preceding the time of the report.

One roentgenogram; 5 photomicrographs.

GEORGE R. KRAUSE, M.D.
Mt. Sinai Hospital of Cleveland

Accelerated Skeletal Development from Thyrotoxicosis and Thyroid Overdosage in Childhood. Bernard Schlesinger and O. D. Fisher. Lancet **2:** 289–290, Aug. 18, 1951.

Hyperthyroidism is uncommon in childhood, especially below the age of five years. The symptoms are similar to those in the adult, except that an increase in the height and skeletal development can be detected when the hyperthyroid state has existed for a sufficiently long time. In juvenile hypothyroidism delayed growth of bone and dwarfed stature are characteristic. Both of these abnormalities can be corrected by administration of thyroid extract. If the dosage is excessive or given over too long a period, however, the correction proceeds too far, accelerating ossification, with the danger of early epiphyseal union, bringing growth to a standstill.

To use the ossification centers as a guide to thyroid dosage, it is necessary to make roentgenographic studies every three to six months. A ratio is then worked out between the x-ray findings and the height measurement, since skeletal development is usually in advance of growth in these circumstances. While the authors believe that repeated estimation of the blood cholesterol level and electrocardiography offer a more delicate test of the efficacy of thyroid dosage, they regard roentgenography as particularly valuable in indicating overdosage.

Three cases (cretinism and mongolism, both treated by thyroid extract, and juvenile thyrotoxicosis) are presented to illustrate the effect of overdosage of the extract and of excessive thyroid secretion on growth and skeletal development.

Four roentgenograms; 1 table.

Chronic Vitamin A Poisoning. Report of a Case. George Bair. J. A. M. A. **146:** 1573–1574, Aug. 25, 1951.

Since the syndrome of hypervitaminosis A was first described by Josephs in 1944 (Am. J. Dis. Child. **67:** 33, 1944), 13 additional cases have been reported. Observers have noted the following characteristic manifestations of the entity: external cortical thickenings of the affected bones, pain and swelling over the long bones, irritability and fretfulness, and increased vitamin A concentration in the blood.

The author presents a case of hypervitaminosis A in a 28-month-old boy with the typical findings and with an unusual cranial bone involvement. Through a mis-

understanding, the child had been given in excess of 4 gm., or 240,000 units, of vitamin A daily, for a period of at least three months. Roentgenograms of the skull showed distinct periosteal new bone formation, less dense than the bones of the calvarium, homogeneous in character, and similar to hyperostosis present in the long bones. The largest patch of cranial hyperostosis was on the undersurface of the occipital bone, extending to and on the left side of the foramen magnum. Smaller, more discrete areas of denser hyperostosis were present in each temporal region, more marked on the left side.

One month after the elimination of all vitamin supplements, roentgen examination revealed that all the hyperostoses except those in the skull had disappeared. Apparently new bone formation in this area persists longer than in other affected bones.

Four roentgenograms; 1 photograph.

Two Curve Patterns in Idiopathic Structural Scoliosis. J. I. P. James. J. Bone & Joint Surg. **33-B:** 399–406, August 1951.

The author discusses the curve patterns in idiopathic structural scoliosis as well as the etiology, prognosis, and treatment of the infantile and the primary lumbar types. He uses the term idiopathic because no cause for the scoliosis was found in the cases studied.

Only 5 to 10 per cent of idiopathic curves become severe enough to require correction and fusion. Early recognition of the type suitable to correction is most important for avoidance of over-treatment of the remaining 90 to 95 per cent of patients. The two chief factors influencing the prognosis seem to be the age of onset and, more important, the pattern of the curve.

Of 33 patients with the infantile type of scoliosis, 21 were boys and 12 girls. Patients with congenital changes in the vertebrae were excluded. The major curve was to the left in 29 of the 33 patients. It usually developed a few months after birth, and three years was considered to be the latest age of onset. In 32 of the 33 cases there was a triple curve, with the major curve in the thoracic region; the apical vertebra was commonly the fourth thoracic.

Primary lumbar idiopathic scoliosis, by contrast, occurs at a later age and is more frequent in females. The major curve was to the right in 18 of 33 cases and to the left in 15. The condition frequently becomes painful, especially towards middle age. Roentgenograms usually reveal a curve with its apex at the first or second lumbar with marked osteoarthritis of the posterior intervertebral joints, which are presumably the seat of the pain. This type has a good prognosis as to deformity but more commonly leads to degenerative arthritis in later life.

Ten roentgenograms; 4 photographs; 7 tables.

ROBERT H. LEAMING, M.D.
Memorial Center, N.Y.

Osteochondritis Dissecans of the Supratrochlear Septum. Charles A. Rowe. California Med. **75:** 106–108, August 1951.

In 1945 Morton and Crysler (J. Bone and Joint Surg. **27:** 12, 1945. Abst. in Radiology **45:** 313, 1945) reported 6 cases of osteochondritis dissecans of the supratrochlear septum, which they believed were the first examples of the condition to be described. The author adds still another. In roentgen studies a sclerotic ovoid fragment of bone was seen in the supratrochlear septum of the right humerus. Observations at operation indicated that the process originated elsewhere and that the fragment migrated to the olecranon fossa, where it lodged and hypertrophied.

Four roentgenograms.

Diodrast Arthrography of the Knee. Robert M. Geist, Jr., Charles C. Whitsett, and C. Robert Hughes. Cleveland Clin. Quart. **18:** 231–236, July 1951.

This is a preliminary report of the authors' first 22 consecutive arthrograms of the knee with 35 per cent Diodrast. This iodine salt solution gives greater contrast than does gas, which is generally used in arthrography.

Ten cubic centimeters of the contrast medium is injected into the knee joint from the lateral side and the knee is manipulated to spread the medium over the joint surfaces. Compression is applied on the anteromedial and anterolateral aspects of the suprapatellar area to force the Diodrast into the joint space. Anteroposterior, postero-anterior, lateral, and oblique stereoscopic views are obtained, the stereoscopic shift being 6 degrees. No significant technical difficulties were encountered. The Diodrast is absorbed in about 30 minutes, and sections of the synovia removed at operation showed no microscopic evidence of reaction to the contrast medium.

Tears of the medial and lateral menisci, ruptures of the anterior cruciate ligament, and Baker's cysts were among the pathologic findings in the series reported.

Two diagrams and 10 roentgenograms are reproduced, illustrating normal and abnormal arthrograms.

BERTRAM LEVIN, M.D.
Chicago, Ill.

Köhler's Disease with Compression Fracture of the Os Naviculare in Children. Jean Heer. Schweiz. med. Wchnschr. **81:** 731–733, July 28, 1951. (In German)

The author describes the case of an 8-year-old boy who had suffered a minor injury to his right foot. An x-ray examination showed Köhler's disease of both feet. The left foot had never been injured. The physical examination revealed nothing abnormal except a high metabolic rate (+47 per cent).

Köhler's disease, first described in 1908 by Alban Köhler, is an aseptic necrosis of the scaphoid of the foot, occurring mostly between the ages of three and nine, and usually clearing up completely within two or three years, with conservative treatment.

A satisfactory explanation as to the etiology has never been given. There are two opinions. According to one, whose main proponent is Schultze, the condition is due solely to trauma; a more or less severe injury must have damaged the bone and an aseptic necrosis follows. Schinz and Uehlinger, on the other hand, regard the condition as the result of a fatigue fracture (*Dauerfraktur*). Apparently it occurs chiefly during periods of weakness of the epiphysis, as when the centers of ossification first appear and then again when the epiphyseal line is about to disappear. Schinz and Uehlinger believe that a certain constitutional factor is also necessary.

The author is inclined to accept the opinion of the latter writers, particularly in view of the fact that in his case there was no history of injury to the left foot. He questions whether a real traumatic fracture of the

scaphoid of the foot in children is possible, and believes that all so-called fractures between the ages of three and nine years may perhaps be due to Köhler's disease. Possibly some thyroid disturbance is a contributing factor.

Four roentgenograms. WM. A. MARSHALL, M.D.
Chicago, Ill.

THE SPINAL CORD

Intramedullary Malignant Teratoma of the Spinal Cord: Report of a Case. Lloyd J. Lemmen and Charles M. Wilson. Arch. Neurol. & Psychiat. **66:** 61–68, July 1951.

Intramedullary teratomas of the spinal cord are rare. In a recent review of the literature, Sachs and Horrax (J. Neurosurg. **6:** 97, 1949) were able to gather only 25 cases of intraspinal teratoid and teratoma. The authors report a case of a malignant trigerminal intramedullary tumor with clinical and pathological features which, so far as it was possible to ascertain, have not been previously reported.

Roentgenologic examination of the patient, a girl of 11 years, showed that from the fifth to the ninth thoracic segments the vertebral canal was enlarged in both the anteroposterior and lateral diameter to approximately twice the normal width. A laminectomy was performed, and a fusiform enlargement of the dura was exposed. The latter was opened, revealing a bifid spinal cord continuous with a grayish neoplasm measuring 5.5 × 3 × 2.5 cm. A longitudinal wedge-shaped resection of the main part of the tumor was carried out, together with decompression both upward and downward to the normal cord. Microscopic examination of the tissue removed revealed a complex teratoma composed of cartilage, bone, fat, mesenchymal tissue, smooth and striated muscle, imperfect glomeruli, thyroid, blood vessels, primitive glands lined with columnar epithelium, nerve tissue, and focal accumulations of cells with irregular dark nuclei and scant cytoplasm, some of which appeared spindle-shaped. In this region mitotic figures were seen.

A second operation was done three and one-half months later because of a large recurrent tumor involving the cord. Because of the size of the mass, no attempt was made to remove it, but biopsy showed a tumor similar to the first. X-ray therapy was carried out postoperatively. In two weeks a total of 2,475 r was administered in divided doses of 150 to 200 r over a 13 × 10-cm. field in the thoracic region (200 kv., 25 ma., 50 cm. target-skin distance, 0.5 mm. Cu and 1.0 mm. Al filtration, 1.0 mm. Cu half-value layer). Following this the patient led a normal life for nine months, after which time neurologic symptoms reappeared, and a localizing electroencephalogram suggested a lesion in the posterior fossa, extending approximately from the midline to the right. To relieve the symptoms a right lateral ventriculostomy was done. Air studies showed enlarged ventricles without distortion or shift. A suboccipital craniotomy revealed a tumor the size of a small green pea at the obex of the fourth ventricle. A third ventriculostomy was performed. There was no improvement and death occurred three and one-half weeks later. The histologic study of the fourth ventricle tumor showed that it was a cyst lined with ciliated pseudostratified columnar epithelium, placed on a wide layer of striated muscle and spindle-shaped cells. In the left pleural cavity there was a soft, circumscribed, oval tumor, 11 × 9 × 4.5 cm., firmly attached to the anterolateral surface of the upper lobe of the lung. Caudal to this tumor was a smaller neoplasm, measuring 2.5 × 1.2 × 0.6 cm., on the parietal pleura. Section of the tumor revealed areas of soft gray-white and firmer yellow-brown tissue and numerous small cystic cavities. The tumor in the chest was built of spindle-shaped cells with poorly visible striations, apparently blastomatous muscle elements; they were mostly arranged in bands surrounded by a delicate connective-tissue network. Occasionally they formed a primitive glandular pattern.

The histologic diagnosis was malignant trigerminal teratoma with extensive invasion of an adenorhabdomyoma into the pleura and throughout the spinal cord and brain stem.

Two roentgenograms; 2 photographs; 6 photomicrographs. BERT H. MALONE, M.D.
Jacksonville, Fla.

GYNECOLOGY AND OBSTETRICS

A Diagnostic Test for Tumors of the Uterine Canal. W. B. Norment. Am. J. Surg. **82:** 240–247, August 1951.

In 1943 (Am. J. Surg. **60:** 56, 1943. Abst. in Radiology **42:** 517, 1944) the author described a lens hysteroscope which he was using at that time for direct inspection of the uterine cavity. He has since devised a water hysteroscope for this purpose, which is much more satisfactory. It consists of a lens system, direct or forward view, arranged so that there is a separate channel for the inflow of water to bathe the end of the lens system to keep it free from blood. There is a separate channel for return flow so that the water may circulate in the uterine cavity and be drawn off continuously. The system is incorporated in a metal sheath, which is first inserted in the uterine cavity with an obturator similar to a male urethroscope. The obturator is then removed and the optical system inserted. The latter is so constructed that it will not project beyond the metal sheath and cause any harm to the uterus.

The hysteroscope may be used (1) for the detection, study, and biopsy under direct vision of tumors of the uterine cavity; (2) for the study of the cervical canal; (3) for the fulguration of small polyps by a fulguration tip carried through the channel of the biopsy taker; (4) for the possible fulguration of fallopian tubes at the cornu junction to produce sterility; (5) for study of the physiology of the endometrium.

All patients with irregular uterine bleeding, in whom, so far as possible, an endocrine disturbance or adnexal disorder has been ruled out, are advised first to have an x-ray examination of the uterus. If a filling defect is shown in the hysterogram, the patient is then examined with the hysteroscope and a biopsy is performed.

The author describes his technic for hysterography and for hysteroscopy and presents a few cases.

Three roentgenograms; 5 photographs.

Errors in Technique and Interpretation of Hysterosalpingography and Tubal Insufflation. Margaret Moore White. J. Obst. & Gynaec. Brit. Emp. **58:** 573–582, August 1951.

In the author's experience with over 6,750 patients submitted to tubal insufflation or hysterosalpingography, the following possible errors of technic and in

interpretation of kymographic tracings and hysterosalpingograms have been observed:

Errors in Technic: (1) Omission of a preliminary roentgenogram of the pelvis. If such a film is not routine, one should at least be taken if salpingography has been performed previously. (2) Failure to test for patency of the cannula prior to its use. (3) Failure to use a cannula suitable for the individual case. (4) Neglecting to warm the opaque medium. If a heavy oil is employed, warming renders it more penetrating. A warm medium is less likely to provoke cornual spasm. (5) Failure to alter the position of the uterus and thereby the tubes, by affixing vulsella to the cervix, when marked angulation of the body of the cervix is present. This may prevent entry of carbon dioxide or fluid into otherwise penetrable tubes. (6) Allowing the contrast medium to escape from the cervix too soon after the first film is taken. One should wait for two or three minutes for cornual spasm to subside and to permit passage of the medium into the fallopian tubes. (7) The use of too great pressure in introducing the medium into the uterus, with resulting gross venous intravasation. (8) The use of an oily preparation when there is reason to suspect infection or when the kymographic tracing has shown tubal stenosis. (9) The injection of an insufficient quantity of medium. (10) An insufficient number of films. (11) Failure to repeat the examination if the diagnosis is in doubt.

Errors in Interpretation of Tubal Insufflation: (1) Mistaking intestinal borborygmi for the escape of gas used in insufflation from the fimbrial end of the tube. This mistake may easily be made if auscultation is performed only momentarily. (2) Mistaking the sound of gas bubbling through a hydrosalpinx or into a fallopian tube occluded fimbrially by adhesions for escape into the peritoneal cavity. (3) Mistaking the sound of gas escaping in small amounts from the cervix for gas escaping from the tubes. This error can be avoided if the person holding the cannula in the cervix also does the auscultating.

Errors in the Interpretation of the Kymographic Tracing: (1) Disregard of the possibility of spasm. (2) Failure to consider the significance of variations from the normal kymogram, absence of fluctuations at raised pressure, or poor fluctuations.

Errors in the Interpretation of Hysterosalpingograms: (1) In assessing the size of the uterus, failure to make allowance for the thickness of the uterine walls. The hysterogram depicts only the cavity of the uterus. (2) Disregard of details of irregularity in the contour of the uterine cavity. (3) Making a diagnosis on the state of the tubes from the salpingogram alone, without correlation with the clinical findings or kymographic tracing. (4) Omission of details as to length of the tubes, their caliber, tortuosity, irregular filling, etc. (5) Mistaking opaque medium still present in the tubes for peritoneal spill. (6) Missing the significance of localization of peritoneal spill—peritoneal pockets. (7) Mistaking other pelvic shadows, calcified nodes, residue in the vagina, etc., for peritoneal spill, an error which can be obviated by taking a preliminary film for comparison.

Twelve roentgenograms.

Radiological Pelvimetry and the General Practitioner. W. Hawksworth and E. P. Allen. J. Obst. & Gynaec. Brit. Emp. **58:** 203–215, April 1951.

The authors suggest that radiological pelvimetry has two distinct spheres of application, one for the general practitioner and one for the specialist obstetrician. The present paper discusses the place of the examination in the obstetrical work of the general practitioner. For the discussion of pelvimetry from the point of view of the specialist, see the following abstract.

It is assumed that the general practitioner will undertake the care only of the normal case and that he uses pelvimetry either as a routine measure in all primigravidae or in selected cases as a coarse sieve to distinguish the clearly normal and adequate pelvis from that which is contracted or misshapen. When the general practitioner refers a patient for pelvimetry he wishes to know whether or not she has an obstetrically adequate and normal pelvis, for upon this depend his arrangements for handling of the case during labor.

On the basis of 371 cases in which an unassisted delivery was completed within twenty-four hours, what may be reported as a "normal" pelvis is described. It is concluded that a pelvis with principal sagittal plane diameters of 120 mm. or over is unlikely to be associated with mechanical difficulties during the course of labor and that disproportion, if it does occur, is likely to be due to malpresentation or a large head, and even then is of minor degree. For the simplified pelvimetry for the general practitioner a single lateral film is recommended, taken preferably in the erect position and as close to term as convenient. The lateral view has the following advantages:

1. If a soundly devised system of immobilization and positioning is used, it can be readily obtained with much less technical difficulty than is encountered in many other radiographic examinations.
2. It is easily measured by applying a simple correction factor for divergent distortion to the observed sagittal plane diameters, and therefore demands of the radiologist only the possession of a ruler and an elementary knowledge of geometry.
3. It is the only projection which will accurately demonstrate the relation of the maximum diameter of the fetal head to the conjugate.
4. It is the projection which conveys the maximum pertinent information of the features of the pelvis of obstetrical interest.
5. It is the indispensable basis of full pelvimetry.
6. If adopted to the rigid exclusion of semi-supine "inlet" projection, it would eliminate many of the crimes now committed in the name of pelvimetry; it is certain that continued reliance on the inlet view is the main reason why radiologists so dislike requests for pelvimetry.
7. It can be the subject of an accurate and factual report by the least experienced of radiologists.

If any additional film is thought to be required, a frontal view with the patient erect or supine is suggested. If this is obtained at a fixed focal film distance, it allows approximate assessment of the coronal plane diameters without accurate measurement, and has in addition the considerable advantage of showing the fetal parts much more clearly than can be done in a lateral film with the apparatus at present available and may thereby allow the detection of fetal abnormalities.

The general practitioner must realize that radiologic pelvimetry is an exact science only in so far as it can provide an accurate visual picture of the bones of the fetal head and the maternal pelvis. It cannot pretend to predict the course of labor as a whole.

Five tables.

Radiological Pelvimetry and the Specialist Obstetrician. W. Hawksworth and E. P. Allen. J. Obst. & Gynaec. Brit. Emp. **58**: 591–607, August 1951.

In an earlier paper the authors discussed radiologic pelvimetry from the point of view of the general practitioner (see preceding abstract). They now discuss its value for the obstetrician, basing their remarks on a study of 45 selected patients delivered in the Department of Obstetrics, Radcliffe Infirmary, Oxford, in all of whom dystocia due to disproportion had either occurred or had been considered likely to occur in the final antenatal assessment of the case. These patients were recalled and sufficient further films obtained to allow full radiological pelvimetry according to the methods used by the radiological author (Allen: Brit. J. Radiol. **20**: 45, 108, 164, 205, 1947. Abst. in Radiology **50**: 137, 272, 428, 1948).

For convenience the cases were divided into several groups according to the prognosis offered on the roentgenologic criteria. There were 11 cases of isolated inlet contraction, of which 10 were flat pelves and 1 generally contracted. Normal labor was not predicted in any case in this group, but it did occur in 2 instances. In 10 cases abnormal vaginal delivery was predicted. Spontaneous delivery occurred in 6 of these, though in 4 it required over twenty-four hours. In 4 cases, section was necessary after failure of trial labor.

Three cases were reported as having isolated midplane contraction on the basis of a midplane area of 95 square centimeters or less. Abnormal vaginal delivery was predicted in all 3 cases, and occurred in all, 2 requiring forceps assistance for cavity arrest and 1 patient having a prolonged labor.

In 4 patients with combined inlet and midplane contraction, abnormal vaginal delivery was predicted in 3. Vaginal delivery occurred in 2 cases, but section was required in the third. In the fourth, trial labor was recommended and vaginal delivery was completed in fifty hours, with forceps removal for a deep transverse arrest in the pelvic cavity.

Seven patients had minor inlet and severe midplane contractions. In only 2 of these was vaginal delivery thought possible, and even these 2 were regarded as distinctly borderline. In both, vaginal delivery occurred after the application of forceps for fetal distress, with the head in the pelvic cavity. In the remaining 5 patients elective section was advocated; in 3 section was performed and in the other 2 delivery was spontaneous, in nineteen hours in one and assisted by rotation of an occipito-posterior head and forceps in the other.

Four patients showed contraction of the pelvis at all levels. Two were thought candidates for vaginal delivery, and in both it occurred, though not without assistance. Section was recommended in the other 2 because of the degree of midplane contraction. In 1 case it became necessary after a trial labor of thirty hours. Assessment was impossible in the fourth case.

Obviously, the radiologist may permit himself considerably more latitude in suggesting normal vaginal delivery when reporting to an obstetrician. In the present series, 13 pelves were considered substantially normal, with only minor reservations. In 6 of these spontaneous delivery occurred. In 5 cases some assistance was necessary. Two patients required section, one for a postmature head in the occipitoposterior position, which would not engage in a long oval brim with a conjugate of 123 mm., and the second as an emergency measure for an occipitoposterior head impacted in the brim after 102 hours of labor and failure of forceps before admission.

Two cases were not classified and were non-assessable. Elective section was carried out in 1 case for placenta praevia and in the other because of the age of the patient and early membrane rupture with fetal distress.

In the 41 assessable cases, the radiologic prediction was correct in 22 and incorrect in 19. In 14 of the 19 incorrect predictions, the radiological report proved too optimistic. There were 10 serious radiological errors in the group of 41 cases; 7 of the errors were associated with factors which could not be predicted radiologically under the conditions of the test, *i.e.*, 5 occipito-posterior positions, 1 inertia, 1 premature rupture of the membranes with fetal distress. In striking contrast are the other 3 errors, in which labor was normal in spite of an adverse prediction.

In an unselected series of cases an overall accuracy of about 85 per cent can be expected. Roentgen pelvimetry can be relied upon to separate cases into those in which normal delivery will take place, those in which section will be required, and a residual borderline group. The division of cases into such groups is ultimately the responsibility of the obstetrician with knowledge of all the factors involved; the help he may obtain from the radiologist is determined largely by his method of practice, radical or conservative. An obstetrician inclined to surgery or unsure of his conduct of a trial labor does not wish the opinion of the radiologist; a formal statement of the shape and size of the pelvis is all he requires, for it is on the basis of his own interpretation that he justifies his elective operation. In conservative obstetrics, however, the actual diameters of the pelvis are not considered of overwhelming importance. They are used rather to augment the clinical impression gained from vaginal examination close to term and to provide a visual impression of its shape. Only in the rarest case is surgery elected on the basis of the radiologic findings alone.

Methods of interpretation of pelvis and fetal head measurements and intrapartum radiography are discussed.

Two tables; 1 figure.

Roentgenpelvimetric Measurements of 3,604 Female Pelves, White, Negro, and Mexican, Compared with Direct Measurements of Todd Anatomic Collection, Richard Torpin. Am. J. Obst. & Gynec. **62**: 279–289, August 1951.

The author has made a study of the female obstetric pelvis and compared the measurements obtained from the isometric inlet grid film in 3,604 pregnant women with actual measurements of 422 dried female pelves from the Todd collection of human skeletons at Western Reserve University School of Medicine. He believes that a single 8 × 10-inch film of the inlet, with use of the isometric grid, provides all the important data necessary to form an adequate clinical opinion concerning the obstetric pelvis. He measures the interspinous diameter of the midpelvis on the same film, using the same grid pattern as is used for the inlet measurements. Ten per cent is added to the grid measurement of the interspinous diameter to compensate for less magnified distortion at the level of the spines than at the level of the inlet.

In general, it was found that the range of measure-

ments within the same racial groups were quite comparable between the series of roentgen pelvimetric examinations and the series of actual measurements on the Todd collection. In both groups the measurements generally ran a little smaller in the Negro pelves than in the white pelves. A group of 296 Mexican pelves examined by the roentgen method tended to run a little larger in average measurements than the white pelves, particularly in the interspinous diameter. In the roentgen studies three diameters were measured: the anteroposterior of the inlet, the transverse of the inlet, and the transverse (interspinous) of the midpelvis.

All the pelves examined were classified according to the four parent types of Caldwell and Moloy, on the basis of the single inlet view of the pelvis. Of the pelves of white women 76.4 per cent were gynecoid, 15.4 per cent anthropoid, 1.6 per cent android, and 6.6 per cent platypelloid. In the Negro women 69.5 per cent were gynecoid, 23.3 per cent anthropoid, 2.5 per cent android, and 2.7 per cent platypelloid. In the Mexican women 71 per cent of the pelves were gynecoid, 24 per cent anthropoid, 1 per cent android, and 4 per cent platypelloid.

One photograph; 13 charts.

T. FREDERICK WEILAND, M.D.
Jefferson Medical College

Joint Discussion on X-Rays and Their Value in the Localization of the Placenta. Frank Reid, Samuel Davidson, J. Chassar Moir, and J. C. McClure Browne. Proc. Roy. Soc. Med. **44:** 703–718, August 1951.

Opening a joint discussion on the use of x-rays in localization of the placenta, Reid stated that during the last three and a half years he had based the radiological diagnosis of placenta praevia on demonstration of the placental shadow, together with displacement of the presenting part from the corresponding portion of the pelvic brim. Five hundred eighteen cases examined during the period from Jan. 1, 1949, to June 30, 1950, are analyzed.

An aluminum wedge-shaped filter is used which reduces the intensity of radiation directed toward the less dense tissues of the interior part of the abdomen. As implantation is nearly always anterior or posterior, a lateral radiograph is necessary to show the placenta in profile. This is taken with the patient erect, so that the fetus tends to rest directly on the anterior uterine wall, thereby lessening the possibility of the amniotic fluid giving rise to a pseudoplacental shadow.

The lower uterine segment extends some 7 to 11 cm. upward from the internal os before the onset of labor. Evidence of the placenta extending downward into the pelvis usually, but not always, indicates implantation on the lower segment. In normal cases with head presentation, the head is from 0.5 to 1.5 cm. distant from both the pubes and the promontory of the sacrum, unless its dimensions are small in relation to the pelvic brim. In the latter event, the effect of gravity being greater toward the pubes, the head is often several centimeters from the promontory; but a semierect position causes the head to gravitate backward, so that the distance becomes within the range of normal.

With an anterior placenta praevia, the head is usually displaced 2.5 cm. or more from the pubes. With a posterior placenta praevia, the distance between the head and promontory of the sacrum in the erect position exceeds 2.5 cm. If the distance is over 2.5 cm., an additional film should be taken with the patient reclining backward before a diagnosis of true displacement is made.

Although implantation on the lower segment is usually anterior or posterior, it frequently extends onto the lateral uterine wall. In such cases, the radiographs show the presenting part displaced not only forward or backward but also to one side of the central pelvic axis.

There are two main reasons why the radiological diagnosis of placenta praevia is less reliable with breech presentations. First, the breech is irregular in shape and therefore fits less closely than the ovoid skull into the lower pole of the uterine cavity; second, owing to technical difficulties, the translucent outline representing subcutaneous fat is not consistently visible in the routine lateral radiograph. In spite of these disadvantages, the method need not be discarded on discovering a breech presentation.

Reid describes briefly two methods of amniography that he has used. One consists in the injection of 3 to 5 c.c. of Lipiodol into the amniotic cavity. By suitable posturing of the patient, it is possible to demonstrate a layer of contrast medium on either the anterior or posterior wall of the lower segment. Another method is the injection of Pyelosil (which belongs to the same group as Skiodan) into the uterus, with the patient in a half-sitting position, following which she sits upright to allow the heavier contrast medium to sink through the fluid to the bottom of the uterine cavity; 20 c.c. of a 70 per cent solution are used.

Davidson, of Birmingham Maternity Hospital, states that there appears to be a definite need for additional aid in the localization of the placenta, such as might be provided by soft-tissue radiography. The method must provide a sufficiently high degree of accuracy in diagnosis when assessed by radiologists generally. It must be employed in selected cases only and not as a routine method of investigation. Soft-tissue radiography should not be considered as more than an aid to diagnosis and must never be allowed to replace careful and complete clinical assessment. It should, however, help to eliminate unnecessary and dangerous digital vaginal examinations.

Moir, of Oxford, says he has found that amniotic fluid, even when present in normal quantity, will in some circumstances produce a shadow which can be confused with the placental shadow as described by Dippel and Brown (Am. J. Obst. & Gynec. **40:** 986, 1940).

Browne, from London, describes a method of localization of the placenta by means of radioactive sodium. Approximately 50 microcuries of radioactive Na^{24}, in the form of 5–20 ml. of sterile isotonic saline, are injected into a suitable antecubital vein. After allowing about thirty seconds for the Na^{24} to mix in the blood stream, radioactivity measurements are made over the abdominal region.

This method depends on the fact that the placenta is essentially a pool of blood and therefore represents a local accumulation of Na^{24} so long as the bulk of the isotope remains in the circulation. It has sometimes been possible to show, by virtue of high readings obtained over the lower uterine segment, that the placenta has low insertion, but failure to obtain these high readings is not held to exclude placenta praevia.

Eight roentgenograms; 5 tables.

HOWARD L. STEINBACH, M.D.
University of California

THE GENITO-URINARY SYSTEM

Urographic Examination of Hypertensive Patients. A. Středa and J. Korbelář. Acta radiol. et cancerol. bohemoslovenica **5**: 66–69, 1951. (In French)

In almost all patients with hypertension there is accelerated filling of the urinary passages in urography. Roentgenograms taken three minutes after injection give good contrast. This is thought to be due chiefly to more rapid tubular secretion.

CHARLES M. NICE, M.D.
University of Minnesota

Spontaneous Pneumourography Following Ureterosigmoid Transplantation. Raymond E. Parks. Am. J. Roentgenol. **66**: 222–230, August 1951.

Since the advent of the sulfonamide and antibiotic drugs, ureterosigmoid transplantation is being performed more frequently because of the possibility of better control of the ascending pyelonephritis that follows the operation. Many operative technics have been described but all can be classified into three broad groups. In the first group, the ureter is tunneled through the submucosa of the colon before penetrating the mucosa to enter the bowel lumen. The second type of procedure, which is not popular at present, is done in two stages: the intact ureter is first laid in a submucosal trough of the colon and later the distal limb of the ureter is severed and the anastomosis established. The third group comprises the simple end-to-side anastomoses. The efficacy of these types of operation in the prevention of ascending urinary tract infection is much debated.

The author reviewed the postoperative films of 33 cases of ureterosigmoid transplantation with special reference to the presence of air in the ureters and renal pelves. Gas was found in the upper urinary tract in 6 cases. In all of these an end-to-side anastomosis had been done, though not all patients having an end-to-side anastomosis showed gas. One patient in whom a group one operation had been done on the right side and a group three (end-to-side) anastomosis on the left side showed gas only on the left side. Clinical observations and studies on the patients with reflux of gas did not differ from those in the group without gas.

No prognostic significance can be attached to the occurrence of gas in the urinary tract following transplantation of the ureters into the colon, but the findings indicate that contamination is more likely to follow an end-to-side type of anastomosis.

Twelve roentgenograms; 3 diagrams; 1 table presenting the 33 cases in summary.

DONALD F. MAURITSON, M.D.
Cleveland City Hospital

Multiple Urethroperineal Fistulas Containing Calculi. Kenneth A. Forbes and Justin J. Cordonnier. Urol. & Cutan. Rev. **55**: 464–466, August 1951.

Only one case of urethroperineal fistulae containing stones was found by the author in the literature of the past thirty years. He reports an additional example.

The origin of the fistulae in this case is rather obscure, since no definite stricture or other obstruction was found. The history suggested that multiple diverticula of the bulbous urethra were the site of calculus formation and that subsequent suppuration led to rupture of the sacs and the production of fistulae. The stones were first discovered when one was seen protruding from a fistulous opening while the patient was being prepared for surgery. Plain films disclosed a number of rather large calculi and urethrography proved that they were in the fistulae. Stones and fistulae were excised with favorable results.

Five roentgenograms. ZAC F. ENDRESS, M.D.
Pontiac, Mich.

Calcification of the Vas Deferens: Its Relation to Diabetes Mellitus and Arteriosclerosis. James L. Wilson and Joseph H. Marks. New England J. Med. **245**: 321–325, Aug. 30, 1951.

The authors have seen 60 patients with calcification in the walls of the vas deferens demonstrated roentgenologically. Of this number, 56 had diabetes mellitus, the average duration of the latter disease being 18.3 years. In general, when the onset of the diabetes is after the age of forty the interval before calcification of the vasa deferentia is relatively short, whereas in patients acquiring diabetes earlier in life at least fifteen years usually intervenes before calcification is noted.

In 2 patients of this series, 1 of whom was a diabetic, an acute or chronic infectious disease seemed to play a role. Both gave histories of severe neisserian infection. In all other patients the condition was attributed to degenerative changes within the wall of the vas deferens, similar to those seen in a medium-sized artery that has undergone arteriosclerotic changes. Arterial calcification was present in 53 of the 60 cases. It was of moderate or severe degree in 33 cases.

Among 39 cases in which the scrotum showed on the roentgenogram, 8 showed evidence of calcification of the extrapelvic portion of the vasa. In the 52 cases in which only the intrapelvic portions were involved, the calcification was limited to the portions of the vasa medial to the ureters. There thus appeared to be some delay in the appearance of calcification in that portion of the vas that lies between the ureter and the inguinal canal. The calcification was bilaterally symmetrical in all but 11 cases.

The finding of a linear calcification in the pelvis of a diabetic male should arouse the observer's interest and incite him to trace its course, to determine whether the calcification is within the vascular system or the genital tract. Calcification of the vas deferens should be suspected when parallel lines of density resembling a calcified artery are seen to pass obliquely downward and medially across the shadow of the obturator foramen. The internal pudendal and testicular arteries are also projected in the obturator foramen and may be calcified. They are of about the same caliber as the vas but can be distinguished from it if sufficiently long segments are calcified. The internal pudendal artery arises from the hypogastric artery, and curves medially below the obturator foramen to supply the tissues around the anus. The testicular artery parallels the vas below the inguinal ring, and can be differentiated if its site of origin in the aorta can be identified.

Some observers believe that two forms of pathological involvement are seen. In the so-called non-inflammatory form, the lumen of the duct remains widely patent, and the calcified deposits are found within the muscular elements that comprise the wall of the duct. On the other hand, after a chronic infection, such as tuberculosis, the inflammatory form of change is most commonly seen. Under these circumstances there may be thrombosis with partial or complete occlusion of the

lumen of the vas, with rupture through the intimal mucosa.

The authors believe that calcification within the vas deferens represents a relatively specific degenerative complication of diabetes.

Four roentgenograms; 1 photomicrograph; 1 table listing all previously reported cases of calcification within the male genital tract.

MORTIMER R. CAMIEL, M.D.
Brooklyn, N. Y.

Compression Belt to Improve Intravenous Pyelograms. Ole A. Nelson and Bertha Iverson. Urol. & Cutan. Rev. **55:** 469–471, August 1951.

To improve the results of intravenous pyelography, the authors have incorporated a blood pressure cuff in a canvas belt for obtaining compression. Pressure is maintained at 90 to 100 mm. of mercury until five-, fifteen-, and twenty-five-minute films are obtained. The pressure is then released and two more films are taken in the horizontal position, followed by an upright exposure.

The compression bag will hold the dye in the pelvis and upper ureters if the patient is able to tolerate it, and the films equal or are even superior to those obtained with the retrograde procedure, provided renal function is good. The films taken after release of the pressure will demonstrate the lower portions of the ureters.

[The authors state that the use of compression to cause retention of the medium in the renal pelvis and ureter is not new. They do not mention, however, a procedure practically identical with their own reported by Zatzkin in Radiology **50:** 639, 1948.]

Four roentgenograms; 1 drawing.

ZAC F. ENDRESS, M.D.
Pontiac, Mich.

THE BLOOD VESSELS

Studies of the Blood Supply of Tumors in Man. III. Vascular Patterns of the Liver by Hepatic Arteriography in Vivo. Howard R. Bierman, Ralph L. Byron, Jr., Keith H. Kelley, and Alice Grady. J. Nat. Cancer Inst. **12:** 107–117, August 1951

Abnormal vascular patterns of the brain in the presence of tumors have been successfully visualized and applied to clinical practice by methods of cerebral angiography. Since it has been demonstrated that neoplasms of other organs often exhibit an increased or abnormal arterial vascularity, the visualization of the blood supply of various organs could permit an additional means of discovering and localizing neoplasms.

The vascular pattern of the liver has been observed occasionally by roentgenographic technic following the administration of radiopaque material into the aorta. The authors have developed the technic of intra-arterial catheterization in order to visualize the vascular pattern of the liver and other viscera in man. This report presents the method and demonstrations of the hepatic arterial circulation by a timed rapid roentgenographic procedure following the injection of radiopaque materials by means of an intra-arterial catheter manipulated into the celiac or hepatic artery.

Fifty patients with various neoplastic lesions, usually involving the liver, were studied. Two or three arteriograms were obtained for each patient at each catheterization. All the procedures were done under local anesthesia except in the case of two children who received general anesthesia. Diodrast or Neo-iopax was used. The catheter was introduced into the brachial or carotid artery and manipulated into the celiac axis and common hepatic artery under fluoroscopic control. Once the catheter was in position, 2 to 4 c.c. of 70 per cent Diodrast, Neo-iopax, or in one case Thorotrast was injected rapidly through the catheter tip. By means of a rapid cassette changer, films were taken at various intervals, up to five seconds, after the last radiopaque material left the syringe.

Nine of the 50 patients had normal hepatic vascular configurations. Of these 9 patients, 4 were found to be without metastasis in the liver at postmortem examination; the other 5 had no clinical or laboratory evidence of visceral involvement and are still alive. The arterial circulation in the uninvolved normal liver exhibited an orderly branching with progressive and gradually diminishing caliber of the vessels as they terminated in the hepatic parenchyma. No gross anastomoses were observed between the vessels outlined by this technic.

The arterial pattern in livers containing metastases was characterized by pooling and increased vascular outlines in the tumors. The small vessels in the involved areas originated from disproportionately large parent arteries in the vicinity, branched abruptly, and formed bizarre disorderly patterns that were characteristic of a neoplastic lesion. Thirty-three of the 41 patients with known hepatic metastases showed these abnormal bizarre patterns. Hepatic arteriograms on 5 other patients showed a decrease in vascularity, particularly of the small terminal vessels. Four of these patients had Hodgkin's disease and the other a hepatoma. In the remaining 3 patients the arteriograms failed to show characteristic massive areas of increased vascularity, although metastasis was present. The areas of opacity observed on the films were correlated with areas of neoplastic involvement of the liver as found by clinical examination, operation, puncture biopsy when possible, and at postmortem examination in 25 patients.

Thirteen arteriograms; 1 anatomical drawing; 1 table presenting clinical data on the cases studied.

D. S. CHILDS, JR., M.D.
Rochester, Minn.

Effect of Physiologic Variables on the Diameter of Small and Large Arterial Vessels. J. Flasher, D. R. Drury, and D. Gordon. Angiology **2:** 302–307, August 1951.

Mercury was used to demonstrate radiographically the large and small arterial vessels in various physiologic states during life in the rabbit. By altering the injection pressure, it was possible to investigate vessels of various sizes. The authors found that the physiologic state of the vessel is not altered by the technic itself for at least fifteen seconds after the occlusion of the circulation that is a necessary first step in the procedure. The physiologic state of 6 different sized vessels can be investigated during this time. Their size is calculated from a formula involving the injection pressure and the surface tension of mercury. A marked lability in the size of the renal arterial vessels, including the renal artery itself, was demonstrated. Arteriovenous shunts larger than 20 micra in diameter were not observed under any conditions.

The authors present evidence for taking a more dynamic view of the kidney vessels, such as is already taken for the vessels of the skin, muscles, and splanchnic areas. The mercury method should also be applicable to the investigation of the living state of the small and larger arterial vessels, and the arterio- and arteriolovenous channels (under various physiologic and pathologic states) of the limbs of the experimental animal.

Three roentgenograms.

Hepatic Venography. A. M. Rappaport. Acta radiol. **36:** 165–171, August 1951.

The author presents a modification of a previously reported method of hepatic vein catheterization in dogs. His method requires the use of "transflex" tubing, French No. 10, of a Foley catheter type. The tubing has at its tip a metal cap and is guided by a metallic leader. The leader tip may be directed forward, to the right, or to the left by a control nut at the base.

The procedure consists of inserting the catheter and leader into the saphenous or femoral vein and passing it upward under fluoroscopic control into the liver veins. As the tip passes into the right or the left liver vein, the balloon at the catheter tip is inflated and this wedges the catheter tightly within the vein. Twenty cubic centimeters of 70 per cent Diodrast are then injected through the catheter into the vein and three or four films are exposed at one-half-second intervals.

The procedure permits excellent "flooding" of the liver segment with opaque material, and the author suggests that it might be used in the demonstration of tumors, abscesses, cysts, and cirrhosis of the liver.

Six roentgenograms; 1 drawing.

I. R. BERGER, M.D.
VA Hospital, Chamblee, Ga.

Thrombophlebitis of the Vena Cava, Innominate Vein, and the Left Subclavian Vein as Complication of an Esophageal Diverticulum. H. R. Renfer. Schweiz. med. Wchnschr. **81:** 750–751, Aug. 4, 1951. (In German)

The author describes an uncommon thrombosis of the innominate and left subclavian veins.

A 68-year-old man, known to have had an esophageal diverticulum for fifteen years, entered the hospital complaining of pain in the left arm and axilla and the left side of the chest. A few days later a progressive cyanotic edema of the left arm and clavicular region developed. Fluoroscopy of the chest showed emphysema bilaterally. The upper mediastinal contour was enlarged and appeared dense. Fluoroscopy of the esophagus showed an atony of the hypopharynx and a diverticulum measuring 9 × 10 cm. on the right side, at the level of the third dorsal vertebra. The wall of the diverticulum was irregular and showed several small filling defects. There was an arterial pressure difference between the two arms, and later the radial pulse on the left could not be detected. Under conservative therapy the severe edema disappeared, and a thrombosis of the left brachial vein was demonstrated by venogram.

No account of similar complications of an esophageal diverticulum could be found in the literature. The arterial pressure difference shows the involvement of the arteries and a local arteriospasm. Venography (60 c.c. "Joduron" 70 per cent, in 2 seconds, in the antecubital fossa) showed the thrombosed veins in direct contact with the diverticulum.

Two roentgenograms. ILONA D. SCOTT, M.D.
VA Hospital, Chamblee, Ga.

Aneurysm of the Renal Artery: Report of Two Cases and Review of the Literature. Benjamin S. Abeshouse. Urol. & Cutan. Rev. **55:** 451–463, August 1951.

A thorough search of the literature and the addition of 2 personal cases bring the total number of reported renal aneurysms to 115. Most of the patients were between forty and sixty years of age, but the extremes were nine months and eighty-two years. These aneurysms, like others, may be true or false and have a varied etiology (congenital, inflammatory, degenerative, and traumatic). The following intrinsic changes in the renal artery are suggested as predisposing to aneurysm formation: traction or angulation of the renal artery by a displaced or enlarged kidney; compression of the artery by an intrarenal or extrarenal mass; changes in the artery due to spasm, neuromuscular dysfunction or splanchnic stimulation. Complications, besides hemorrhage from rupture, include pressure effects from the mass of the aneurysm and diminution of blood flow in the vessel beyond the aneurysm. No consistent location was found for the aneurysms; 5 patients had more than one renal aneurysm.

Smaller lesions were usually discovered accidentally, having produced no symptoms or signs. In the larger ones pain, hematuria, a palpable mass, tenderness, hypertension, and systolic bruit or pulsation occurred in that order of frequency. Only 25 of the 115 cases were diagnosed before operation or autopsy, and in all of these the diagnosis was made on x-ray evidence. In 6 others there was a calcified ring shadow but its significance was not appreciated.

Pyelography and laminagraphy may help locate such a calcified shadow more accurately, but the most complete information is obtained by aortography (percutaneous or retrograde catheterization).

Treatment is necessarily surgical and in most cases involves nephrectomy, since it is usually not possible to remove the aneurysm without occluding the artery. Two cases are reported in detail and 4 roentgenograms are reproduced. ZAC F. ENDRESS, M.D.
Pontiac, Mich.

Ruptured Aneurysm of the Splenic Artery: Case Report with Discussion. George W. Zeluff and Victor Parsonnet. Ann. Int. Med. **35:** 437–443, August 1951.

Rupture of an aneurysm of the splenic artery is a rare cause of acute blood loss. The case reported here is of interest, since ample time was available for surgery if the diagnosis had been made and also because of the unusual site of rupture. The patient was a woman of 32 first seen following the diagnosis of pleural effusion by her physician. Thoracentesis a few weeks prior to admission had yielded about a quart of brown fluid but this had reaccumulated. During the patient's stay in the hospital the left chest was repeatedly tapped, a total of 9,400 c.c. of fluid being removed. Anemia was progressive and the spleen was greatly enlarged. Roentgenograms revealed the left pleural effusion and a mediastinal shift to the right. Death occurred suddenly, and autopsy showed a saccular

aneurysm 1 cm. from the origin of the splenic artery and extending for 2.5 cm. along its course. The aneurysmal sac measured 10 cm. in diameter and was filled with old and freshly clotted blood. Many outpouches of varying size arose from it; one of these extended along the proximal portion of the splenic artery to a point beneath the posterior surface of the right leaf of the diaphragm. Several of these reached the left leaf of the diaphragm, one of which was adherent to and had extended through the diaphragm and ruptured into the left pleural cavity. Blood had also escaped into the peritoneal cavity.

Multiple factors may be responsible for the formation of splenic artery aneurysms Most frequent are arteriosclerosis, septic emboli, and congenital anomalies. Occasionally trauma, "wandering spleen," Gaucher's disease, Banti's disease, syphilis, and medial necrosis have been cited as playing a role. In the present case the only two of these factors to come into consideration are a congenital anomaly and medial necrosis. The former appears unlikely, as the aneurysm was not located at a point of branching and because no other aneurysms or congenital anomalies were found.

The aneurysm may rupture in one of two ways: the rupture may be sudden, with rapidly fatal blood loss, or it may be in stages. The latter may be prolonged from several hours to months, the terminal episode being one of rapid hemorrhage. The site of the rupture is varied. The sites, in descending order of frequency, are the peritoneal cavity, retroperitoneal tissue, stomach, colon, pancreas, and combinations thereof. No previous case has been reported of rupture into the thoracic cavity.

Two roentgenograms. STEPHEN N. TAGER, M.D.
Evansville, Ind.

TECHNIC

On Roentgenography at 200 kV. K. Lindblom. Acta radiol. **36:** 162–164, August 1951.

The author considered the large skin doses administered in roentgen cinematography and the long exposure time required in gastro-intestinal roentgenography of some patients to be sufficient cause for experimenting with radiographic technic at 200 kv. In May 1950, a four-valve apparatus for exposures at a maximum of 200 kv. was installed in the Karolinska Sjukhuset (Stockholm). The ma. capacity at this voltage is 100, but lack of a rotating anode has prevented the use of a "total effect live load."

Two roentgenograms illustrate the slight loss in contrast which results with this tube. There is, however, a reduction of dose to the tube side of the skin to less than one-eighth that received at 100 kv. It is thought that the decrease in contrast may be easily compensated for when combination with the Morgan television method of image amplification is possible.

I. R. BERGER, M.D.
VA Hospital, Chamblee, Ga.

New Design of Radiopaque Element for Surgical Sponges. George Levene. J. A. M. A. **146:** 1320–1321, Aug. 4, 1951.

The author describes a method for marking a surgical sponge so that it may be easily recognized on a roentgenogram. It consists of a new design of radiopaque element vulcanized into the sponge so that it cannot be shaken out. The opacity and pattern of this opaque element are such that it can be visualized and identified in any part of the body.

One roentgenogram.

RADIOTHERAPY

Radiotherapeutic Physics. A Symposium. I. The Physical Aspects of Treatment of Cancer by 22 MeV X-Rays. H. E. Johns, E. K. Darby, and R. O. Kornelsen. **II. Dosage in Irradiated Soft Tissue and Bone.** F. W. Spiers, with an Appendix by W. J. Meredith. **III. A Survey of Hospital Physics Activities at the Institute of Radiophysics, Stockholm.** Sven Benner. **IV. Some Developments of the Physical Aspects of Teleradium Therapy.** C. W. Wilson. **V. Dosage Control in Interstitial Gamma-Ray Therapy.** W. J. Meredith. **VI. Some Aspects of the Problem of Dosage Estimation in X-Ray Treatment.** L. F. Lamerton. **VII. An Instrument for Dosage Estimation with Fields of Any Size and Shape.** B. M. Wheatley. Brit. J. Radiol. **24:** 355–391, July 1951.

The first paper in this Symposium on radiotherapeutic physics comes from the University of Saskatchewan and gives in considerable detail the methods of measurement and operation of a 22-mev betatron. With such high energy beams the "skin dose" is small, varying from 15 to 21 per cent and is biologically not of great importance. The dose 2 to 4 mm. below the skin is more significant. It was found to vary from 32 to 36 per cent. Methods of collimating the beam, the use of the compensating filter, calibration, and monitoring are discussed. Dosage measurements were made in wax, lucite, water, and air, with satisfactory agreement between theoretical calculations and actual measurements. The integral dose was found to be substantially smaller than for beams of lower energy. The effects of a skin surface at an angle to the central ray were briefly studied and are presented as isodose charts.

Energy absorption in tissues of different densities is briefly discussed. Bone was found to have about 6 per cent greater selective absorption than at 2 mev. This is regarded as of doubtful clinical significance.

Spiers discusses variations in absorption produced in the body because of irregular distribution of bone, muscle, and air, as in the chest. The results are presented in the form of graphs and tables giving the results in ion pairs per cubic micron per r.

Benner outlines experimental developments at the Institute of Radiophysics in Stockholm. A brief description of a "flash-roentgen" tube is given. This is energized by a condenser discharge system. It has a large anode so constructed that simultaneous crossfiring can be accomplished. An instrument for measuring neutron doses, designed by Sievert, is also described. Another development that is being worked on is an instrument that will be a combination of dose meter and dose-rate meter.

Wilson outlines the method developed for accurately directing the beam in teleradium installations. This is done by making a plaster cast of the part to be irradiated on which wax seatings are placed, giving the correct location and angulation into which the applicator can be set. This has proved useful in carcinoma of the head and neck.

Meredith briefly reviews the problem of measuring accurately the dosage of interstitial radium, giving greatest attention to the method of radiographing the needles after insertion. From the radiographs a reconstruction is made and phantom measurements obtained.

Lamerton discusses the aspects of accurate dosage estimation in x-ray treatment. He points out three problems: how much accuracy is desired, what is the effect of bone, air spaces, etc., and the size and shape of the fields.

Wheatley describes an ingenious machine for finding the depth dose for a field of any size, by means of a light and lens system with a revolving template, based upon isodose curves.

Forty-five figures and graphs; 6 tables.

SYDNEY J. HAWLEY, M.D.
Seattle, Wash.

Radiation Chemistry. A Symposium. I. Radiation Chemistry in Relation to Radiobiology. C. B. Allsopp. **II. Elementary Processes in the Radiation Chemistry of Water and Implications for Radiobiology.** Milton Burton. **III. Hydrogen Peroxide Formation in Water Exposed to Ionizing Radiations.** P. Bonét-Maury. **IV. A Review of the Evidence for the Production of Free Radicals in Water Consequent on the Absorption of Ionizing Radiations.** F. S. Dainton. **V. Some Aspects of Biochemical Effects of Ionizing Radiations.** W. M. Dale. **VI. Radiation Chemistry of Organic Halogen Compounds.** W. Minder. Brit. J. Radiol. **24:** 413–440, August 1951.

This symposium would appear to be of considerable interest and importance for those interested in the chemical aspects of radiation. The papers, however, are so compactly written that they seem unabstractable. Therapeutic radiologists who wish to make a start in the chemistry of radiation effects are referred to the original text. They will gain more from its perusal if a competent chemist is on hand to assist in its interpretation.

Nineteen graphs. SYDNEY J. HAWLEY, M.D.
Seattle, Wash.

Supervoltage Radiotherapy. Eugene T. Leddy. S. Clin. North America **31:** 1207–1215, August 1951.

Leddy offers a clear, basic discussion on supervoltage therapy, and a comparison with 200 kv. therapy.

The object of supervoltage therapy (500 kv. to 30,000 kv.) is to reproduce the gamma radiation produced naturally by radium, and to bring about greater destruction of deep-seated cancer while sparing normal tissues. With these high voltages the depth dose is more or less independent of the size of the field irradiated. The hard rays are scattered less than the softer ones produced by lower voltages, and as the voltage rises the scattering is more and more in the direction of the primary beam.

The advantages of supervoltage roentgen therapy over 200-kv. therapy are:

1. Relative independence of depth dose and field size; the field need not be any larger than the tumor.
2. Less injury to normal tissues, because the dose may be administered to a small field.
3. More favorable relationship between tumor dose and total dose. At 200 kv., a tumor will absorb only about 5 per cent of the radiations which reach the body; at 1,000 kv., the tumor will absorb about 12 per cent.
4. Reduction of injury to the skin because there is less back-scatter.
5. The possibility of administering effective doses through a single field because of the greater penetration.

Certain disadvantages are as follows:

1. High cost of the machine and its installation.
2. Lack of flexibility of the machine.
3. The high exit dose, making it difficult to crossfire a lesion.
4. The limit of safety is not skin tolerance, but the sensitivity of the organs and tissues adjacent to the deep-seated tumor. This increases the risk of injury to the patient.
5. A tumor may require much more radiation if supervoltage therapy is used.
6. There is no evidence that any tumor is more sensitive to supervoltage roentgen rays than it is to rays generated at 200 kv.

The author relates the experiences of numerous investigators with the use of supervoltage radiation in various tumors, including esophagus, pituitary, bladder, uterus, and mouth. FRANK T. MORAN, M.D.
Lancaster, Penna.

Radium and Surgical Treatment of Retinoblastoma. Robert E. Fricke, Martin Van Herik, and John W. Henderson. S. Clin. North America **31:** 1147–1155, August 1951.

Retinoblastoma is an inclusive term for malignant growths originating in the retina in young children. Either eye may be affected, with bilateral occurrence in about 25 per cent of the patients.

When the diagnosis has been established and only one eye is involved, there is general agreement that enucleation is the procedure of choice. When the neoplasm is bilateral, it is usually of unequal severity in the two eyes. In this situation the eye containing the larger mass is removed, and the other eye is treated by irradiation. When both eyes are equally involved, the decision as to removal of both eyes, or removal of one and irradiation of the other, may be difficult. The safest procedure from the standpoint of life expectancy is to perform bilateral enucleations.

Retinoblastoma is moderately radiosensitive, and may be radiocurable. Radiotherapy is indicated: (1) in patients who are seen early, while the tumor is still localized; (2) in postoperative cases when either optic nerve or orbital involvement is present; (3) when the disease is so extensive that surgery is contraindicated.

Both radium and roentgen rays are used in the treatment of retinoblastoma. The authors prefer radium, using a combination of external, intracavitary, and interstitial application. They have developed two applicators capable of holding three and four gold radon tubes, respectively. These consist of brass plaques with a concave surface, applied under intravenous anesthesia directly to the globe at the location of the tumor. A minimal tumor dose of 3,500 gamma roentgens is delivered. Whenever possible, this is supplemented by external radium therapy, begun on the following day.

External treatment is administered by means of a square lucite applicator, which uses four tubes containing 50 mg. of radium each, filtered by 1 mm. of platinum, at a radium-skin distance of 2.5 cm. The affected eye is treated through three separate ports, anterior, oblique, and lateral. Each port receives 2,800 mg. hours over a period of fourteen hours.

The intracavitary treatment may be repeated once, and the external therapy may be repeated several times at intervals of three months. Almost invariably there is late formation of cataracts.

Postoperative radium therapy is always administered in those cases in which there is invasion of either the optic nerve or orbit. In these instances intracavitary radium may be supplemented by two or three 1-millicurie radon seeds implanted into the optic nerve.

Radiologically treated patients should be given monthly re-examinations. After an interval of three months, a second course of therapy is given to those patients who have not undergone surgery, even though the tumor has regressed.

A review of 88 cases of retinoblastoma at the Mayo Clinic showed a 50 per cent five-year survival rate for surgically treated patients, and 45 per cent five-year survival rate for patients treated exclusively with radium. Nearly all of these, however, were treated by external radium alone, before the advent of the intracavitary applicator.

Two figures; 2 tables. FRANK T. MORAN, M.D.
Lancaster, Penna.

A Method of Treatment of Neoplasms of the Posterior End of Alveolus. K. Sicher. Brit. J. Radiol. **24:** 403–404, July 1951.

An ingenious method of directing the beam in irradiation of the posterior portion of the alveolar ridge is described. A mould, made of acrylic resin, is constructed in two parts, in each of which is a semicircular channel. When the two parts are put together a tunnel is formed through which the intra-oral applicator is introduced. The mould is held in place by the jaws. If the tunnel is accurately made, proper direction is assured and maintained.

Two photographs. SYDNEY J. HAWLEY, M.D.
Seattle, Wash.

X-Ray Therapy in Carcinoma of the Esophagus. T. A. Watson and E. M. Brown. J. Thoracic Surg. **22:** 216–218, August 1951.

Epidermoid carcinoma of the esophagus may be eradicated by properly planned roentgen therapy, though the mortality is high whether x-ray or surgical treatment be employed. Surgery promises little more than removal of the primary lesion, and the procedure is usually mutilating. With roentgen therapy a normally functioning esophagus can be achieved without mutilation. This is shown by gross and microscopic study of 4 post-irradiation cases.

The first patient died thirty-eight months after therapy, with widespread metastases but complete local eradication of the esophageal tumor. The second patient lived fifteen months after therapy and died of congestive heart failure. No evidence of tumor was found postmortem, either local or metastatic. In the third case an old inactive focus of tuberculosis became active following treatment, and death ensued after four months. No residual cancer was found in the esophagus and no metastases were present. The fourth patient died three months after treatment. The local tumor site had not healed properly, but no tumor was found in the esophagus or elsewhere. All four cases had been proved by biopsy before treatment.

DONALD DEF. BAUER, M.D.
St. Paul, Minn.

Sarcoma of the Uterus, a Clinical Study. W. Norman Thornton, Jr., and John P. Carter. Am. J. Obst. & Gynec. **62:** 294–301, August 1951.

Twenty-four cases of sarcoma of the uterus seen at the University of Virginia Hospital are presented. Fourteen of the neoplasms appeared to arise in the myometrium, and 6 of these were in such close association with a fibromyoma as to suggest origin from that source. In 2 cases the tumor apparently arose in the endometrial stroma. In 8 instances classification as to site of origin was not attempted. This last group included 3 cases of carcinosarcoma and 2 of sarcoma botryoides.

Twenty-two patients were adults, with an average age of fifty-four years; 2 were children. Among the adults the disease was postmenopausal in 17 cases and premenopausal in 5. Postmenopausal bleeding occurred in 9 cases. Other symptoms were abdominal or back pain, enlargement of the abdomen, menometrorrhagia, purulent vaginal discharge, urinary retention, frequency, nocturia, and a sensation of pressure on the bladder. A tentative impression of a malignant growth was entertained in 8 cases, although no preoperative diagnoses were made. Among 7 patients subjected to dilatation and curettage, a diagnosis of sarcoma was made in 3 and suspected in 1. Four patients had received intracavitary irradiation for menometrorrhagia eleven to fifteen years prior to the diagnosis of sarcoma. Curettage prior to irradiation had shown no evidence of malignancy.

Two of the 3 cases in which the diagnosis was established by biopsy were considered inoperable and treated with radiation only. The other was not treated.

Nineteen cases were treated surgically, 10 by total and 9 by subtotal hysterectomy. Eight of the surgical cases were given roentgen therapy, 4 as an adjunct to surgery, and 4 for subsequent recurrence or metastasis. One patient received radium pack therapy for vaginal recurrence.

One patient underwent radical excision of a radioresistant pelvic recurrence two years after total hysterectomy. A second recurrence responded neither to x-rays nor to nitrogen mustard.

The most common site of metastasis from uterine sarcoma is the lung. One case of pulmonary metastasis was treated with nitrogen mustard without benefit.

There was only one five-year survival among 12 adult cases treated prior to 1945.

Of the 2 children, one, aged thirteen months, had a mass protruding from the vagina, and the second, five years old, had vaginal bleeding. The first is still alive without recurrence three and a half years after receiving 4,000 r of x-ray therapy. In the second child, the tumor was considered too far advanced for treatment.

Four photomicrographs; 1 chart; 7 tables.
MASON WHITMORE, M.D.
Jefferson Medical College

Transperitoneal Implantation of Low Intensity Radium Needles. Preliminary Report. R. S. Clayton. Texas State J. Med. **47:** 552–559, August 1951.

The author introduces his preliminary report on the transperitoneal implantation of low-intensity radium needles with an excellent résumé of historical milestones in the treatment of carcinoma of the cervix. He points out that to plan a reasonably safe technic designed to destroy foci of cancer of the cervix in the parametria and pelvic walls there are two important factors to be

considered, the normal tissue tolerance limit and the minimal lethal dose for the carcinoma.

From his experiments on 9 dogs in which radium needles of low intensity were implanted by a transperitoneal approach, there is no indication that serious damage is produced in the pelvic viscera by 10,000 gamma roentgens delivered in 168 hours to the tissues of the pelvic wall. These needles were easily and safely removed through a stab incision in the left lower quadrant of the abdomen.

Another important aspect is that exploration of the pelvis by laparotomy leaves little doubt in the mind of the operator as to persistent tumor, which may not be appreciated with even the best bimanual examination, particularly in obese patients.

Three cases are also reported in which low-intensity radium needles were implanted transperitoneally. It is believed that the procedure should prove of definite value in the treatment of carcinoma of the cervix but no conclusions are reached concerning the curability of metastases. From his investigation the author suggests a more careful development of the method. If it proves to be sound, exploratory laparotomy might be done in all clinical stages of the disease.

Eight roentgenograms; 1 table.

ROBERT H. LEAMING, M.D.
Memorial Center, N.Y.

Carcinoma of the Ovary. H. Dabney Kerr and H. B. Elkins. Am. J. Roentgenol. **66:** 184–189, August 1951.

The authors have reviewed 165 cases of carcinoma of the ovary treated surgically, with postoperative irradiation, from 1930 to 1944 inclusive. All cases were proved histopathologically. The classification is a slight modification of that of Heyman. *Group I:* Those cases in which removal of all the primary tumor and all visible metastases was possible. *Group II:* Those who had (*a*) ascites with malignant cells or spill of malignant cells into the peritoneal cavity at time of operation or (*b*) partial or total removal of the primary lesion but with visible metastases remaining. *Group III:* Recurrence of malignant tumor following either operation or irradiation. *Group IV:* Inoperable tumor; exploration or paracentesis only; distant metastases.

The five-year survival rate for the entire group of cases was 31.5 per cent. In Group I, the five-year survival rate was 52.1 per cent; Group II*a*, 42.8 per cent; Group II*b*, 37.2 per cent; Group III, 8.3 per cent and Group IV, 4.3 per cent.

The series included 79 cases of papillary cystadenocarcinoma, 62 cases of solid carcinoma, 14 cases of pseudomucinous cystadenocarcinoma, 3 cases of teratoma with malignant changes, 2 cases of dysgerminoma, 2 cases of granulosa-cell carcinoma, 1 fibrosarcoma, 1 malignant ovarian cyst, and 1 cystadenoma malignum. Pseudomucinous cystadenocarcinoma showed the best prognosis, with 46 per cent alive and well at five years. Papillary cystadenocarcinoma was next best with 42 per cent, and solid carcinoma was poorest with only a 16 per cent five-year survival. Of the 17 patients with papillary cystadenocarcinoma alive at five years, 7 (41 per cent) later died of the disease. Of these 7 cases, 5 (71 per cent) fell in Group II*b*. Thus patients with this type of disease must be followed for at least seven years before statistics based on survival are of much value. This is particularly true of those with peritoneal implants.

The technical factors used by the authors were: 200 kv., 8 or 20 ma., 50 cm. distance, and Thoraeus filter (half-value layer 1.95 mm. Cu). Two anterior, posterior, and lateral 10 × 15-cm. fields were ordinarily used, and doses of 200 r to each of two fields were given in rotation for six days a week. Each field was given from 1,800 to 2,400 r, air dose, depending on the patient's size and condition. An attempt was made to deliver a mid-pelvic dose of at least 4,000 r in a period not to exceed five weeks. When extensive involvement was present, a second course of treatment was given to the upper abdomen through anterior, posterior, and lateral fields measuring 10 × 15 cm. Often this second course was not completed because of the poor condition of the patient and the frequent occurrence of nausea and vomiting.

Two graphs; 4 tables.

HARRY HAUSER, M.D.
Cleveland City Hospital

Giant Follicle Lymphoma Followed by Pregnancies. Case Report. W. Ronald Frazier. West. J. Surg. **59:** 405–408, August 1951.

A 27-year-old woman, seen because of increasing size of the abdomen, was found on physical examination to have a large, firm, irregular mass occupying the entire upper right quadrant, and most of the left upper quadrant. The spleen was enlarged, and bilateral inguinal lymph nodes and an enlarged left cervical lymph node were palpable. The latter was removed for biopsy, and after much discussion a diagnosis of giant follicle lymphoma was made.

The patient was given a series of x-ray treatments, receiving a total of 2,772 r to the anterior abdomen in divided doses, three times a week over a period of thirty-two days. During this time she also received 380 r to the left and right neck.

She returned for observation three months and twelve months after irradiation. Amenorrhea had been complete in the interval. No palpable masses or abnormal findings were present except for a persistent leukopenia of 3,000.

Two years after irradiation the patient began to have irregular periods; five years following treatment she gave birth to a normal infant, and nine years after irradiation she delivered twins. After eleven years she was living and well.

Other cases are cited from the literature in which deep roentgen therapy to the pelvis was followed by normal pregnancies.

FRANK T. MORAN, M.D.
Lancaster, Penna.

Roentgen Therapy of Exophthalmos. Franco Fossati and Franco Silvestrini. Radiol. med. (Milan) **37:** 609–621, August 1951. (In Italian)

The authors have treated 6 patients with marked exophthalmos by roentgen irradiation. One of the number had a normal basal metabolic rate, one had a rate of −3, and the others rates of +18, +48, +40 and +49. Treatment was given to two temporoparietal fields and one frontal field on alternate days, 150 r per session for a total dose of 900 r per field. The results were excellent in 2 patients and good in 2, while 2 showed no benefit from the treatment. There was no apparent relationship between the basal metabolic rate and the results obtained.

Four photographs.

CESARE GIANTURCO, M.D.
Urbana, Ill.

Thyroiditis: Concepts of Management. A. Lanham Allen and Robert J. Reeves. West Virginia M.J. **47:** 258–269, August 1951.

The authors report 63 cases of thyroiditis seen over a twenty-year period at Duke Hospital (Durham, N.C.). The classification of thyroiditis is discussed and the presented cases are divided into three classes: subacute thyroiditis, struma lymphomatosa (Hashimoto), and struma fibrosa (Riedel). The clinical picture and pathologic findings are presented for each of the classifications.

The authors believe that duration of illness in cases of subacute thyroiditis is shortened by irradiation of the thyroid gland. The tenderness and pain are reduced straightway and the swelling subsides in a matter of two to three weeks. Few cases recur following x-ray therapy. The general principles of radiotherapy for inflammations by the use of small dosage are followed. The suggested exposure is from 100 to 150 r on alternate days through a single portal just sufficient to cover the thyroid gland, to a total dose of 800 to 1,000 r.

In cases of Hashimoto's disease the authors consider irradiation and surgery equally effective. In cases of Riedel's disease surgical treatment is indicated .

The question of whether fibrosis of the thyroid gland results from x-ray irradiation is discussed at length. It is concluded that this "old myth" has been disproved. Radiation in sufficient amounts to injure the parenchyma of the thyroid gland causes first ulceration and then necrosis of the surrounding skin.

Four tables; 1 graph. D. S. CHILDS, JR., M.D.
Rochester, Minn.

Painful Shoulder Due to Calcareous Tendonitis. R. Carter Crain. Illinois M. J. **100:** 133–135, August 1951.

During the period Jan. 1, 1948, to April 1, 1949, 186 patients with painful shoulder, all showing definite areas of calcification in one or more of the tendons of the shoulder cuff, were treated by roentgen therapy. The right shoulder was affected in 114 cases. Sixty of the patients were women. The youngest patient was twenty-four years of age, and the oldest seventy-eight.

The technical factors of irradiation were: 200 kv., 18 ma., 50 cm. distance; Thoraeus filter; h.v.l. 2.0 mm. Cu. Treatment was given to one anterior and one posterior field, each measuring 10 × 10 cm., 200 r (in air) being delivered to one field at each visit. The fields were treated alternately. Treatments were given every second or third day for a total of four to six. The total dose in air over each field, therefore, varied from 400 to 800 r. The patient was advised to carry the arm in a sling for at least one week. As soon as the pain diminished, instructions were given to practice internal and external rotation and abduction several times each day.

Replies to a questionnaire were received from 117 of the 186 patients (62 per cent). Fifty-nine patients reported complete relief and 42 partial relief. Twelve patients were unimproved.

Whenever possible, roentgenograms are made from one to six months after treatment. On the basis of the findings plus clinical observations at the follow-up examination, it is clear that complete freedom of movement with no pain may be obtained without the disappearance of the calcareous mass, although both the density and size of the shadow in the films are usually decreased in those patients who are for the moment free from pain. Unless the deposit is entirely absorbed after the course of treatment, recurrence of pain at some later date is probable.

Four roentgenograms.

Simple Method of Making X-Ray Shields for Small Ports. Jeff Davis and Eva Davis. Arch. Dermat. & Syph. **64:** 369–370, September 1951.

A knife or scissors is generally employed to cut openings in pieces of sheet lead to make them conform to and closely shield small ports on the skin in preparation for x-ray therapy. When a circular opening is required, the process is tedious and unsatisfactory. It is difficult to make a perfect circle with these instruments, and the cut edge is rough.

The authors have found ordinary cork borers, which may be obtained from chemical supply houses, very satisfactory for cutting holes of the proper diameter. They come in sets of various sizes, and those of larger bore are available individually. A metal plunger is included with each set. The cylinders are open at both ends. Therefore, the lesion may be seen by placing the cylinder over the area to be treated and the size suitable for the particular lesion selected. The closely graduated borers enable allowance for the exact amount of normal skin margin which it is desirable to include in the treatment. When the proper size borer has been selected, its cutting edge is placed upon the piece of lead to be employed and with one turn of the wrist and mild pressure the opening is made.

One photograph.

RADIOISOTOPES

Isotope Research and Clinical Radiology. B. V. A. Low-Beer. Proc. Roy. Soc. Med. **44:** 663–672, August 1951.

In an address to the Royal Society of Medicine, the author evaluated the status of isotope research and clinical radiology. He pointed out that radioisotopes constitute a valuable addition to existing tools for investigation of biochemical processes and for the diagnosis and radiological treatment of certain diseases.

The use of radioisotopes of elements which are metabolites makes possible the study of the dynamics of digestion, assimilation, and excretion, whereas classical chemistry affords methods of analyzing only static conditions. The use of radioisotopes expands the field of roentgenology from the study of macroscopic morphology to an investigation of constituents of tissues, cell aggregates, and single cells. The introduction of the time factor in such studies also brings radiology into the realm of cell physiology. Qualitative and quantitative effects of radiation emitted by radioisotopes constitute a limiting factor in the study of living organisms.

Radioisotopes have been used for the past seventeen years as an important adjunct to clinical medicine in three general lines of investigation: (1) distribution of active and passive metabolites in the body; (2) investigation of some mechanisms of metabolism; (3) investigation of therapeutic applicability of artificial radioactive isotopes. The author cites examples of the

usefulness of radioisotopes in these three lines of investigation:

(1) P^{32} is especially useful in the study of distribution patterns within the body, since it is a universal cell metabolite. Radiophosphorus and radioiron have been used in measuring circulating red cell volume. Radiosodium has been employed for the determination of extracellular fluid volume and for the determination of blood volume. Radioiodine has had an extensive application in the study of thyroid function, in the hope of establishing the differential diagnosis of hyperthyroidism, hypothyroidism, thyroiditis, and thyroid carcinoma.

(2) Radiophosphorus is used in the study of phospholipid metabolism. A single large dose of either choline or methionine, which produces an increase in the rate of phospholipid turnover, is administered to patients with cirrhosis of the liver. This suggests that cirrhosis of the liver is associated with a relative deficiency in lipotropic agents, since it has been demonstrated that phospholipid concentration is a measure of liver function.

Studies with radiosodium have indicated a break-down in the antisodium barrier between intracellular and extracellular fluids in shock. In patients in shock the sodium space is increased without commensurate increase in body fluid. The use of radioiron in shock has demonstrated widespread stagnation of red cells, and indicates the wisdom of introducing red cells as well as plasma in such cases.

The introduction of the time factor in radioiodine studies of thyroid function has shown the usefulness of this technic. The whole picture, which includes not only the initial avidity of thyroid tissue for iodine but also the rate of retention, turnover, and excretion, provides more reliable clues to the questions of thyroid function and thyroid impairment.

(3) Radioisotopes have proved valuable in a variety of conditions as therapeutic agents. Radioisotopes applied topically are easily controlled sources of radiation, similar in effect to x-rays and radium, but subject to some limitations. When they are administered internally, their effect depends on the biochemical properties of the radioactive substance used.

As an example of the topical therapeutic use of radioisotopes, the author cites the use of radiophosphorus incorporated in disodium hydrogen phosphate, soaked into blotting paper of known dimensions in measured amount, and applied over superficial carcinomas of the skin, hyperkeratosis, or hemangiomas.

Radiocobalt has proved useful for intercavitary and interstitial irradiation. It has been employed for tumors of the maxillary sinus, nasopharynx, urinary bladder, and uterine body.

Radiophosphorus administered intravenously in fractionated doses may produce remissions in chronic myeloid and lymphatic leukemia. It is of no avail in acute leukemia, but may be useful in temporary control of lymphosarcoma, Hodgkin's disease, and mycosis fungoides, provided lymph nodes and lesions in specific cases show a selective uptake of the isotope. It is the treatment of choice in polycythemia vera.

The availability of carrier-free radioiodine since the end of World War II has greatly stimulated the use of this isotope in treatment of hyperthyroidism.

HOWARD L. STEINBACH, M.D.
University of California

Practical Aspects of Radioactive Isotopes in Relation to Medical Treatment. Joseph S. Mitchell. Brit. M. J. 2: 747–757, Sept. 29, 1951.

Theoretical Aspects of Isotopes in Relation to Medicine. A. Wormall. Ibid., pp. 757–762.

These two papers were originally delivered as lectures before the Society of Apothecaries in London.

Mitchell surveys the medical applications of the radioactive isotopes, considering each of the three main groups—those administered internally, those used as gamma ray sources, and those used as external beta ray sources. The more important individual isotopes he discusses in detail.

A table listing the therapeutic applications of these substances and classifying them according to their present usefulness at the levels of practical treatment, clinical trials with definite promise of practical value, and preliminary studies indicates the scope of the article.

1. Administered internally
   - Selectively concentrated
     - Soluble inorganic
       - Practical treatment.. P^{32}, I^{131}
       - Clinical trials..... I^{130}
       - Preliminary studies.. Ca^{45}, Sr^{89}, Ga^{72}, As^{76}, At^{211}, ThC
     - Colloidal inorganic
       - Clinical trials..... Au^{198}
       - Preliminary studies.. $CrP^{32}O$, $Mn^{52}O_2$, Zn^{65}, Cu^{64}, Y^{90}, Zr^{95}, Ag^{111}
   - Uniformly distributed
     - Clinical trials..... Na^{24}
2. Gamma ray sources
   - Practical treatment.. Co^{60}, Ir^{192}
   - Clinical trials..... Ta^{182}, Na^{24} (intracavitary application)
   - Preliminary studies.. Br^{82}, I^{131}
3. Beta ray sources
   - Practical treatment.. P^{32}
   - Clinical trials..... Sr^{90}-Y^{90}
   - Preliminary studies.. Ru^{106}-Rh^{106}, Ce^{144}-Pr^{144}

In the course of his paper the author describes the radio-iridium unit in use at Addenbrooke's Hospital, Cambridge, England.

Five illustrations; 2 tables.

Wormall attempts to outline theoretical aspects of isotopes in their relation to medicine, describing the preparation of radioactive compounds, the methods for their detection and estimation, the health hazards associated with their use, the advantages and disadvantages of the tracer technic and its application in the study of immunity, chemotherapy, and metabolism. In connection with metabolic studies he mentions especially the tracking of the precursors of creatine, one of the important constituents of muscle. "The use of isotopic tracers," he writes, "has led to the discarding of the old theory of a dual type of metabolism in the cells of the animal body; an exogenous metabolism of energy-bearing food material brought to the cell, and an entirely independent endogenous metabolism involving breakdown and repair of tissue cells. We now recognize that in the animal body there is a dynamic equilibrium, with food substances and cell components all forming what has been termed a 'metabolic pool.' All the tissues are supplied with this pool mixture of relatively simple compounds such as acetate, pyruvate, etc., and these

compounds are used for combustion or tissue-building irrespective of their origin. This new concept, for which we are particularly indebted to Schoenheimer and Rittenberg, may be the isotopic tracer technique's finest achievement up to date."

Four illustrations; 1 table.

Instrumentation for I^{131} Use in Medical Studies. Benedict Cassen, Lawrence Curtis, Clifton Reed, and Raymond Libby. Nucleonics **9:** 46–50, August 1951.

Scintillation counters have proved useful for the detection of gamma radiation from tissue. Several types have been designed at the University of California Laboratories in Los Angeles. With one of these, previously described (Nucleonics **6:** 78, 1950) and subsequently improved, it is possible to detect easily, with 1/4-in. resolution, the boundary of a region containing only 0.2 μc of radioiodine per square centimeter and to delineate with fair accuracy the thyroid glands of patients given 150 μc of radioiodine.

A hand-held localizing counter has also been developed, using an RCA 7151 photomultiplier tube. As a localizing detector, this counter is more sensitive than the preceding type.

A third instrument is the wide-angle scintillation counter, with the calcium crystals cemented to the face of the photomultiplier. By this means thyroid uptake and biological half-life studies could be made with 1 μc or less administered dose. The performance of this counter is nicely detailed in a straightforward, understandable fashion.

Finally, the authors describe an automatic scanner and recorder utilizing the localizing scintillation counter mentioned in the first paragraph of this abstract. Automatically recorded outlines of thyroid glands obtained with this instrument are reproduced.

Six figures. S. F. THOMAS, M.D.
Palo Alto, Calif.

Distribution of Radio-Iodine in Human Thyroid Gland. Selwyn Taylor and Frank S. Stewart. Lancet **2:** 232–235, Aug. 11, 1951.

A technic for measuring the spatial distribution of radioiodine in the thyroid gland is described. It employs the directional Geiger-Müller counter designed by Veall (Brit. J. Radiol. **23:** 527, 1950), which is shielded or collimated so as to admit mainly a narrow pencil of rays within a small solid angle around the axis. The position of the counter over the patient's neck is determined by means of a jig made of three sheets of Perspex joined at right angles to one another and engraved with lines at 1 cm. intervals, forming a set of rectangular coordinates. A Perspex end-piece with cross-lines is attached to the counter, perpendicular to its axis. By this means the counter is located over any desired intersection of the coordinates, with its axis always perpendicular to one of the three planes.

The distance of the counter from the radiation source is not defined, but the response is almost independent of the distance. When the pencil of rays entering the counter is narrow compared with the size of the source, the counts lost through increased distance are offset by the increased volume of the source "seen" by the counter.

The thyroid is studied thirty to fifty hours after the administration of the radioiodine in an aqueous solution (100 mc.). Counts are made at individual points for periods of one-half to one minute, and enough points to map out the distribution of the radioiodine in the gland can usually be obtained in forty-five to ninety minutes. If the observations are plotted on graph paper in their relative positions, contours passing through points of equal counting rate can be drawn like the isobars on a weather map.

Examples of the results obtained from the normal gland and in various pathological conditions are presented.

Eleven illustrations.

Metabolic Studies with I^{131} Labeled Thyroid Compounds: Distribution and Excretion of Radiodiiodotyrosine in Human Beings. A. Albert and F. Raymond Keating, Jr. J. Clin. Endocrinol. **11:** 996–1011, September 1951.

The metabolism of radioactive diiodotyrosine was studied in 3 myxedematous patients by administering intravenously from 1 to 2 mg. of diiodotyrosine labeled with I^{131}. Serial fractionation procedures were performed on samples of blood and urine, serial *in vivo* observations of radioactivity were made, and the total fecal excretion of I^{131} was determined.

It was found that the radioactive diiodotyrosine disappeared rapidly from the blood and was replaced by radioactive iodide. The initial volume of distribution of diiodotyrosine corresponded to blood volume (85 c.c./kg.), but within two hours diffusion into a much larger compartment corresponding to 530 c.c./kg. occurred.

Only small quantities of radiodiiodotyrosine were excreted in the urine, and this only during the first six hours following injection. The greatest proportion of the urinary I^{131} consisted of iodide during the first few hours, and subsequent to this time all of the urinary I^{131} was in the form of iodide. The renal clearance of radiodiiodotyrosine was 5.2 c.c. per minute, a fifth of the renal clearance of the radioiodide liberated from it.

An average of 3 per cent of the administered radioactivity was found in the feces.

No localization of I^{131} occurred in any of the sites (right and left epigastrium, neck, left thigh) measured by an *in vivo* counter.

Three charts; 8 tables.

Distribution of I^{131} in Tissue Obtained at Necropsy or at Surgical Operation in Man. George S. Kurland and A. Stone Freedberg. With the technical assistance of Mary J. McManus. J. Clin. Endocrinol. **11:** 843–856, August 1951.

The distribution of I^{131} was studied in 13 patients. Seven euthyroid patients were given 300 to 850 microcuries of carrier-free I^{131}, from four to one hundred and sixty-eight hours before orchiectomy or oophorectomy. In the other 6 cases, a dose of 1.7 to 43 millicuries of the radioactive iodine was administered from one to eighty days before death. The data indicate that the major portion of the radiation from the administered I^{131} was delivered to the thyroid gland; other organs received only a small fraction of that amount, 1 per cent or less. In most instances the organs, in order of decreasing I^{131} uptake per gram of tissue, were lung, kidney, pituitary, liver, gonad, spleen, adrenal, and pancreas. Four pituitary glands contained 0.004, 0.025, 0.75 and

0.9 per cent per gram of tissue compared to the thyroid; in a fifth pituitary gland the activity was not measurable. Bone marrow was obtained in 3 cases. In one instance the bone marrow studied eighty days after I^{131} administration, when the blood I^{131} level would be very low, contained more I^{131} than any other organ except the thyroid gland. In a second case the bone marrow contained more I^{131} than any other non-thyroid organ except the liver. The uptake in the ovaries was unmeasurable in 2 cases and was 0.0006 and 0.0019 per cent of the administered dose in another 2 cases. The radiation to the testis was measurable in all instances; the uptake in the operative cases varied from 0.001 to 0.011 per cent of the test dose. In one case, in which marked testicular edema had been present, the testis examined at necropsy contained 0.02 per cent.

The above data indicating a relatively small amount of radiation delivered to organs other than the thyroid are consistent with the authors' clinical experience in 215 cases treated with total doses of from 1.7 to 209 millicuries. Evidence of immediate injury to the bone marrow, kidney, liver or gonads has not been obtained following doses of this magnitude.

Nine tables.

Comparison of a Single G-M Tube Method and a Multitube Method of Assaying I^{131} Uptake by the Human Thyroid. Martin Perlmutter, Shirley Weisenfeld, and Monroe Mufson. J. Clin. Endocrinol. **11:** 1012–1020, September 1951.

Direct measurement of the accumulation of I^{131} by external counting over the thyroid gland with a single Geiger-Müller counter has been employed extensively. However, Freedberg, et al. (J. Clin. Endocrinol. **10:** 910, 1950. Abst. in Radiology **57:** 150, 1951), believed that with this method errors in the recorded counts, due to variation in gland size and location, were large. They therefore devised a method which they considered more accurate, using four Geiger-Müller tubes connected in a parallel electric circuit and arranged horizontally in a circle. Hertz and his associates have also reported upon the use of a four-tube counter (Science **111:** 576, 1950).

The present study was initiated to compare the efficacy of the single Geiger-Müller tube and a four-tube multicounter method in assaying the I^{131} content of the human thyroid. The mean error of triplicate readings by the single-tube method was found to be 3.3 per cent as compared to a mean error of 5.4 per cent by the multitube method. As recorded by the single-tube method, the thyroid gland uptake was 20 to 33 per cent greater than that recorded by the multicounter method.

When the source of radiation was in a vial containing I^{131}, strapped to the neck, the single-tube method recorded an increase of 5 to 10 per cent over the control count, whereas the multicounter method recorded a decrease of 24 to 30 per cent. When the neck was interposed between the source and the single Geiger-Müller tube, only 35 per cent of the control count was recorded.

Despite a 1-cm. variation in the position of the source of radiation, the single-tube method recorded counts with an error of less than 5 per cent when the Geiger-Müller tube was at least 30 cm. from the source.

The authors conclude that the single Geiger-Müller tube method is satisfactory, provided sensitive gamma-counting tubes are used and provided the distance between the tube and the patient's neck is not less than 30 cm. In their experience, the single tube method is preferable to the multitube method used in their experiments.

Six tables; 1 graph.

Effects of Certain Antithyroid Drugs on the Uptake of Radioactive Iodine by the Frog Thyroid. Walter O. Bradley. Biol. Bull. **101:** 62–70, August 1951.

The iodine-concentration capacity of the thyroid gland, as measured by the uptake of radioactive iodine, was depressed in frogs injected with thiourea, sulfanilamide, and potassium thiocyanate. The subcutaneous injection of 0.5 c.c. of a 10 per cent solution of thiourea and of sulfanilamide, and 1 c.c. of a 0.2 per cent solution of potassium thiocyanate into normal frogs resulted in an enlarged, hyperemic, and hyperplastic thyroid gland. The thyroid hyperplasia which occurred under the influence of these drugs was a secondary compensatory response to the increased thyrotropic hormone output by the hypophysis. Inhibition was most pronounced with thiourea, sulfanilamide and potassium thiocyanate following in that order.

Injected potassium thiocyanate was rapidly removed from the blood stream, and its elimination was practically complete in twenty-four hours. However, the iodine-concentrating capacity of the thyroid gland, as measured by the uptake of radioactive iodine, was depressed by potassium thiocyanate, provided a high concentration of the drug was still present in the circulation. After twenty-four hours, the enlarged thyroids of the potassium thiocyanate-treated frogs had a greater capacity than normal for absorbing injected radioactive iodine.

The experiments described do not permit conclusions concerning all the details bringing about inhibition of iodine-concentrating capacity of the thyroid by the drugs mentioned, but it is assumed that iodine absorption is only one of the many steps in the manufacture of thyroid hormone which is in some way hindered. A fuller understanding of the processes controlling normal thyroid function would aid greatly in the interpretation of the whole mechanism of the goitrogenic effect of these compounds.

Four graphs.

Experiences in the Treatment of Diseases of the Thyroid Gland with Radioactive Iodine. U. V. Portmann, Robert A. Hays, E. Perry McCullagh, and Charles E. Richards. Am. J. Roentgenol. **66:** 179–183, August 1951.

This report deals with the results of treatment by I^{131} in a group of 281 selected cases of hyperthyroidism. Diagnosis and the effect of therapy were evaluated by the clinical course, basal metabolism rate, estimated weight of the thyroid, and the occasional use of blood cholesterol and protein-bound iodine levels.

Dosage was related to the size and type of goiter. About 7 millicuries was given as an initial dose for diffuse toxic goiter in patients with small glands (approximately twice normal size), and 14 to 17 millicuries to patients with large thyroids or severe hyperthyroidism. For patients with multinodular glands the initial dose was 20 or 25 millicuries.

Of 203 patients treated for diffuse toxic goiter, 194 were followed at least three months. A dose averaging 12 millicuries caused remission in 60 per cent of 181 patients with diffuse toxic goiter within four months. A

recrudescence of thyrotoxicosis occurred in 5 patients after primary control. Hypothyroidism was the only complication.

Seventy-eight patients were treated for nodular goiter. Twenty-three per cent still had hyperthyroidism at the time of the report. Of the group which responded, 69 per cent required more than 14 millicuries of I^{131}. A longer delay was noted before response than in the group with Graves' disease. Although reduction in gland size was remarkable during treatment, there was no correlation with the duration before remission and the initial size.

Five tables; 1 graph.

EDWARD E. TENNANT, M.D.
Cleveland City Hospital

Observations and Results in the Treatment of Hyperthyroidism with Radioactive Iodine (I^{131}). Wendell G. Scott, William B. Seaman, Cyril MacBryde, Leo Gottlieb, William H. Daughaday, and Bernard J. Sweeney. Am. J. Roentgenol. **66:** 171–178, August 1951.

Of 269 patients treated with radioactive iodine, 195 were available for follow-up for over a period of six months. Treatment was utilized in all diffuse toxic goiter patients over thirty years of age, selected younger patients, and certain hyperthyroid patients with multinodular goiter. An average dose of 0.15 to 0.2 millicuries I^{131} was given per gram of thyroid as determined by palpation. A higher dose in nodular goiter or recurrent postoperative cases was used. Successive doses were given as needed.

One hundred and seventeen patients received the drug for diffuse goiter, and 64 (55 per cent) of these responded to the initial dose. Of 26 patients who received a second dose, 14 showed a satisfactory response. Four patients who received more than one dose and 25 others required supplemental thyroid therapy.

Eighteen (51 per cent) of 35 patients treated for nodular goiter responded to the initial dose, and 8 of this number required thyroid therapy. Of 13 patients given a second dose, 7 responded well. Five received further treatment, and 3 responded.

Of 36 postoperative recurrent thyrotoxicosis patients, 19 (53 per cent) were controlled by one dose. One of these required thyroid therapy. Two patients in a group of 7 responded to a second dose. Of 7 patients treated following failure of roentgen therapy, 2 responded.

Approximately 20 per cent of all treated patients required continuous supplemental therapy. Mild nausea and anorexia and occasional temporary increase in signs and symptoms were noted following treatment in a few cases. Diffuse goiters decreased in size.

In patients with Graves' disease, a higher percentage of hypothyroidism was seen as the dose was increased over 0.2 millicuries per gram. Nodular goiter patients showed more failures than successes with 0.24 millicuries per gram. Hypothyroidism increased directly with further increase of the dose.

Four photographs; 5 tables.

EDWARD E. TENNANT, M.D.
Cleveland City Hospital

Treatment of Thyrotoxicosis with Radioactive Iodine. G. W. Blomfield, J. C. Jones, A. G. Macgregor, H. Miller, and E. J. Wayne. Brit. M. J. **2:** 373–381, Aug. 18, 1951.

The two primary methods of treatment of thyrotoxicosis and toxic adenomata are by surgical extirpation and use of antithyroid drugs. Roentgen irradiation may be satisfactory in some cases but it is difficult to get an adequate dosage to the gland without damaging skin, trachea, and esophagus. Since iodine is specifically concentrated in the thyroid, it is possible to deliver a very high dosage locally with radioactive iodine, with minimal effects on surrounding tissues and other parts of the body. Beta radiation provides the main therapeutic effect and does not travel more than 2.2 mm. in tissue.

The selection of dosage is of fundamental importance. Most investigators attempt to give 100 to 200 microcuries per gram of estimated thyroid mass. The authors seek to deliver 8,000 to 10,000 equivalent roentgens to the thyroid. Factors to be considered are amount of uptake (calculated from tracer studies), rate of elimination of iodine from the thyroid, and estimated mass of the gland. The latter is determined by careful palpation, which may be aided later by a carefully collimated Geiger counter.

The authors have restricted their use of radioactive iodine therapy to the older age groups because of possible late effects of the radiation. Their series includes poor operative risks, those with recurrent disease postoperatively, those who have had reactions to methyl thiouracil, and those experiencing relapse after at least one year of treatment with thiouracil. All were thoroughly studied by recognized laboratory methods and toxicity was graded. All were treated as in-patients, with segregation and careful supervision of all details.

The final figures (presented in an Addendum) show 51 patients treated, of whom 30 had been observed for three or more months. Of these, 21 were euthyroid, 1 hypothyroid, and 8 were improved but not yet normal. Eighteen of the 21 euthyroid patients were treated with a single dose delivering an average of 9,500 equivalent roentgens to the gland. All of the 15 observed for ten months or longer were cured, as were 7 of the 15 observed under ten months.

In no case was there any local reaction to therapy, and there was no hoarseness, laryngitis, or salivary gland reaction. No general reactions were noted in this series, though nausea and occasional sickness may follow large doses (100 mc. or more) for treatment of malignant disease of the thyroid. Transient hypothyroidism occurred in 2 cases. One patient had an attack of gout one week after a therapeutic dose and 2 others had some flare-up of old rheumatoid arthritis. Congestive heart failure had been recurrent in one patient prior to treatment and recurred after her second dose of radioactive iodine. No detrimental effects on the hemopoietic system were found. No alterations in menstrual function were noted.

The authors feel that surgery is still the treatment of choice in thyrotoxicosis when the gland is large or there are pressure effects. The advantages of radioactive iodine are the complete lack of mortality or morbidity, the avoidance of the unpleasantness of operation, and the absence of scarring. It is possible to secure remission of the disease in a high percentage of cases. The disadvantages are the possible late adverse effects and the special care and equipment necessary to carry out the therapy successfully. Radioactive iodine is not suitable for the immediate treatment of patients critically ill of thyrotoxicosis or those with thyrotoxic heart failure. These patients must be prepared by conventional methods much as they would be for surgery.

Close collaboration of the physician, radiotherapist, and physicist is necessary to carry out treatment successfully.

Two illustrations; 4 tables.

BERNARD S. KALAYJIAN, M.D.
Detroit, Mich.

Treatment of Incapacitated Euthyroid Cardiac Patients by Producing Hypothyroidism with Radioactive Iodine. Herrman L. Blumgart, A. Stone Freedberg, and George S. Kurland. New England J. Med. **245:** 83–91, July 19, 1951.

This paper summarizes the authors' experience in treating 37 patients with chronic heart disease by lessening the cardiac work through inducing hypothyroidism with radioactive iodine (I^{131}). Each patient was believed to be euthyroid on the basis of clinical criteria, the basal metabolic rate, serum cholesterol, and tracer doses of radioiodine. Most of the 37 patients were chronic invalids, confined to a bed-and-chair existence, or were unable to undertake more than slight exertion without experiencing angina pectoris or recurrence of congestive failure. Every patient had been incapacitated for many months or years in spite of having received the usually accepted medical therapeutic measures.

Twenty-six patients with angina pectoris were treated, and 17 of these have been observed in the hypometabolic state for a long enough period to permit evaluation. In 11 the therapeutic result was found to be decidedly beneficial; in each instance the patient had been able to undertake activities hitherto impossible for many months or years. In 7 of the 11 patients, the results were considered to be remarkable.

Of 11 patients with congestive failure who have been treated, 6 have been observed in the hypometabolic state for a long enough period to permit evaluation (six to twenty-six months). Four of the 6 patients have shown worth-while improvement.

The program of treatment is as follows: A tracer dose of from 100 to 150 microcuries of I^{131} is administered, and the uptake of the isotope by the thyroid measured. From these data the biologic half-life is estimated, and the equivalent dosage in roentgens delivered to the thyroid is calculated. The initial dose is calculated to deliver approximately 30,000 to 50,000 equivalent roentgens. The patient is followed at one- to two-week intervals, and careful inquiry is made as to the early signs of hypometabolism. When hypometabolism has not developed within several months, additional doses of radioiodine have been given. A total dose range is from 25.5 to 200 mc. The average dose is 64.5 mc. The largest single dose was 51 mc.

In some cases the authors permit marked hypothyroidism to occur, and in some cases the degree of hypothyroidism is controlled by administration of thyroid extract.

Four figures; 1 table. D. S. CHILDS, JR., M.D.
Rochester, Minn.

A Method for the Determination of Small Doses of I-131 in the Urine. W. E. Goodwin and W. D. Harris. J. Lab. & Clin. Path. **38:** 470–473, September 1951.

A method of measuring small doses of I^{131} in the urine, with the aid of a scintillation counter, is described. This method eliminates absorption, pipetting, and drying errors common to the usual counting procedures, and the results are comparable to those obtained by other technics.

One illustration; 1 table.

Evaluation of Radiophosphorus Therapy in Primary Polycythemia. Charles F. Stroebel, Byron E. Hall, and Gertrude L. Pease. J. A. M. A. **146:** 1301–1307, Aug. 4, 1951.

The authors studied 199 cases of primary polycythemia receiving radiophosphorus therapy at the Mayo Clinic. The basic requirements for the diagnosis were (1) sustained elevation of the erythrocyte count above 6,000,000, (2) sustained hematocrit of more than 55 per cent in the presence of normal or increased total blood volume. In the pre-treatment phase several factors were considered: duration and subjective symptoms, degree and elevation of erythrocyte volume, degree of myelopathy, presence of hyperuricemia, degree of splenomegaly, incidence of vascular complications and response to treatment other than radiophosphorus therapy.

Three "general" types were revealed: (1) increased erythrocyte volume in the presence of normal or increased total blood volume; (2) polycythemia plus evidence of pan-myelopathy; (3) either of the other two types plus history of vascular accidents. Leukemoid reactions occurred more commonly with long duration of the disease.

A study of 32 patients with primary polycythemia treated with means other than radiophosphorus showed a very high incidence of death from vascular accidents (56.3 per cent), occurring in the first decade of illness. Leukemia occurred in 12.5 per cent and was later in appearance.

Before administration of the radiophosphorus, repeated venesections are done until the hematocrit reaches 55 per cent or less. The isotope is given intravenously in doses of from 5 to 7 millicuries, injections being repeated at intervals of six to eight weeks (if blood studies remain abnormal) until a remission is obtained. Reactions are rare.

One hundred and forty-eight patients were available for evaluation of results. The authors believe there is a decided reduction in the incidence of vascular accidents in the radiophosphorus group. While comparison of the incidence of leukemia with that following other forms of therapy is premature, since radiophosphorus has only been used for a decade, the great reduction in the incidence of vascular accidents is believed to outweigh this danger. The incidence of leukemia in the present series was 3 per cent.

In 75 per cent of the cases remissions of over one year were obtained. Ninety per cent of the cases of simple polycythemia were successfully treated.

Seven tables. LAWRENCE A. DAVIS, M.D.
University of Louisville

Uses of Radioactive Gold Colloid in Therapy and Palliation of Neoplastic Disease. William N. Harsha. West. J. Surg. **59:** 358–362, July 1951.

The author feels that radioactive gold colloid has many of the qualities of an ideal agent for local irradiation of a tumor. Whereas with radium the alpha and beta rays are screened off and only the long-range gamma radiation is utilized, thus irradiating healthy tissue, Au^{198} radiation ionization is in great part (90 per cent) due to

beta rays, making possible intense local irradiation. Where Au^{198} is evenly distributed through a volume of material, radiation equivalent to 7,600 r is delivered with a gold concentration of 0.1 millicurie per gram of tissue. Au^{198} is prepared in strengths of 15 to 20 mc. per cubic centimeter.

Radioactive gold may be used intravenously in Hodgkin's disease, lymphosarcoma, and leukemia; it may be injected directly into a tumor, or it may be instilled into body cavities (pleural space, peritoneum) involved by malignant disease. In the latter case, as much fluid should be drawn off as possible prior to the introduction of the colloidal gold, so that the surfaces of the involved cavities will be coated with the isotope. When this is done, it may be possible to reduce the fluid formation in ascites or in pleural effusion, and to dry up the involved sites.

The author presents 3 cases in which he utilized Au^{198} in an attempt to treat palliatively pleural and peritoneal exudation due to malignant disease. The radiogold was found to be concentrated in lymph nodes in therapeutic amounts. The hematologic effects of administration of Au^{198} are described. To avoid damage to the blood-forming organs care in administration and strict supervision are essential.

Two roentgenograms; 3 charts.

SIDNEY KING, M.D.
Hancock, Mich.

Observations with Radioactive Hydrogen (H^3) in Experimental Atherosclerosis. Max W. Biggs and David Kritchevsky. Circulation **4**: 34–42, July 1951.

With the use of radioactive hydrogen (tritium), studies were made on rabbits to determine some aspects of exogenous and endogenous cholesterol metabolism under normal and hypercholesterolemic conditions. Since previous studies had shown that in cholesterol synthesis *in vivo*, hydrogen from body water is incorporated into the molecule, it was possible to label the body water, maintain constant levels, and observe the amount of cholesterol found in various body tissues. Particular attention was paid to the amount found in atheromatous areas in the aorta.

Rabbits were fed unlabeled cholesterol until they developed an elevated serum cholesterol. Part of the animals were then fed labeled cholesterol, while in the others the body water was labeled. In most body tissues, including the aorta, it was shown that the specific activity reached much higher levels in animals fed labeled cholesterol, indicating that most of the cholesterol was of exogenous origin. This was particularly true in the atheromatous areas in the aorta. Differences were also found in amount of labeled cholesterol in the tissues in normal and in hypercholesterolemic animals, with more in the latter group seven days after a single feeding. Esterified cholesterol was found to reach a higher specific activity in the serum than free cholesterol. Cholesterol synthesis was found to continue in the body even in the face of massive prolonged cholesterol feeding by mouth.

Five graphs; 8 tables.

BERNARD S. KALAYJIAN, M.D.
Detroit, Mich.

Fixation of Radioactive Digitoxin by Isolated Hearts. A. Sjoerdsma and C. S. Fischer. Circulation **4**: 100–104, July 1951.

Using the isolated perfused hearts of the rat, guinea-pig, rabbit, and cat, the authors made studies to determine the fate of digitoxin labeled with $carbon^{14}$. By comparing the radioactivity of the solutions before and after perfusion, it was possible to obtain a measure of the rapidity of digitoxin fixation. The total fixed by rat and guinea-pig hearts was quite constant and averaged 1.49 and 1.76 micrograms of digitoxin per gram of heart, respectively. Fifty-nine and 68 per cent of the radioactivity was present as unchanged digitoxin. The fixation by rabbit and cat hearts was variable, but the averages were 0.65 and 0.83 microgram per gram of heart, with radioactivity percentages of 70 and 62 as digitoxin.

The mode of digitoxin fixation is unknown. To learn if the process is reversible, hearts of the same species were first perfused with labeled digitoxin solution and then washed with non-radioactive Ringer-Locke solution. There was a progressive decline in the amount of fixed digitoxin with increased amounts of washing and it was particularly easy to wash digitoxin from the rat heart. It was concluded that a considerable percentage of the digitoxin fixed in heart muscle is changed to other substances, the nature of which is unknown, and that while much of the digitoxin and its metabolites could be removed by washing, some (except in the rat heart) always remained.

One figure; 2 tables.

BERNARD S. KALAYJIAN, M.D.
Detroit, Mich.

EFFECTS OF IRRADIATION

Role of Infection in Radiation Injury. C. Phillip Miller, Carolyn W. Hammond, and Marianne Tompkins. J. Lab. & Clin. Med. **38**: 331–343, September 1951.

The investigation described here was undertaken in an effort to estimate the importance of infection as a factor in the death of animals exposed to ionizing radiation.

Male white mice, averaging 20 gm. in weight, were subjected to 600 or 450 r total-body irradiation in a single exposure. Physical factors were: 250 kv., 15 ma., distance 27 inches, 0.5 mm. copper and 3 mm. bakelite filters; rate, approximately 20 r per minute. Five hundred and eighty-three mice received 600 r and 1,035 mice 450 r. The LD 50 for these mice was determined to be 393 r.

In the 600 r series, 288 mice were killed and cultured (at the rate of 20 a day); 113 showed positive cultures from heart's blood and/or spleen. Eighty per cent of the positive cultures occurred during the second week post-irradiation, the period of greatest mortality. In the 450 r series, 595 mice were killed and cultured (at the rate of 35 a day), and 152 showed positive cultures from heart's blood and/or spleen, 66 per cent of the positive cultures being obtained during the second week after irradiation.

As stated above, these experiments had as their single purpose the evaluation of the role of infection as a cause of death in radiation injury. They were undertaken in the hope of answering the question raised by previous workers: whether such infection occurs merely as a terminal event in an animal already dying of

radiation injury or whether infection, once initiated, leads inevitably to death. The authors' results seem to support the latter alternative. Most of the mice were suffering from an overwhelming sepsis at the time they were killed. The source of infection was the lower gastro-intestinal tract.

Further experiments were carried out in which bacteremia was prevented by the administration of antibiotics. This resulted in a reduction in mortality of significant degree (Science **111**: 719, 1950).

Two figures; 5 tables.

Modification of Irradiation Injury in Mice and Guinea Pigs by Bone Marrow Injections. Egon Lorenz, Delta Uphoff, T. R. Reid, and Emma Shelton. J. Nat. Cancer Inst. **12**: 197–201, August 1951.

Jacobson has reported that protection of the surgically mobilized spleen by lead during irradiation effectively protects mice exposed to doses of irradiation that would kill them without the spleen protection. He believes that a humoral factor may be responsible for the reduced mortality. This paper investigates the possibility that seeding the organism after irradiation with hematopoietic tissue and thus creating centers of hematopoietic activity might also have a beneficial effect upon survival.

Boné marrow suspension obtained from mice and guinea-pigs by aspirating the marrow of long bones was injected either intravenously or intraperitoneally into animals following exposure to 900 r of x-radiation. The data indicate that bone marrow injected either intravenously or intraperitoneally post-irradiation gives excellent protection from the acute irradiation syndrome. Of 28 controls injected with saline, none survived the twenty-eight-day period. Of 21 given intravenous bone marrow following irradiation, 76 per cent survived, and of 16 animals given bone marrow intraperitoneally 75 per cent survived.

Histologic examination of different organs of the mice injected intravenously with bone marrow revealed small but active areas of hematopoietic activity in the sinusoids of the liver, though hematopoietic centers do not normally appear in the livers of irradiated mice. The authors conclude tentatively that the areas of hematopoiesis in the liver sinusoids of the experimental areas arose from the injected bone marrow.

Three figures; 1 table.

[For a more detailed study of the protective effect of bone marrow injections see Radiology **58**: 863, June 1952.] D. S. CHILDS, JR., M.D.
Rochester, Minn.

Radiological Defense Against the Atom Bomb. D. A. Russell. Ohio State M. J. **47**: 633–638, July 1951.

This paper was delivered before the Medical Staff of St. Joseph's Hospital, Columbus, Ohio, with the purpose of presenting practical data on the detection, diagnosis, and treatment of radiation injuries and radiation contamination that may follow an atomic bomb attack. The author believes that the primary need is to educate the public and dispel the fear of the radioactive phase of atomic warfare. Secondly, more training courses should be set up to give down-to-earth information which will enable both physician and layman better to handle themselves and casualties in the event of such a catastrophe.